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ELECTRICAL ENGINEERS AND THE PUBLIC[1]

MEMBERS of the American Institute of Electrical Engineers are pleased to refer to electrical engineering as a profession, and to the Institute itself as a professional society. When this occurs as a thoughtless repetition of fine-sounding words, it has little meaning, since mere repetition of an alleged truth does not make it a real truth, and it can be established as a real truth only by tracing it to some adequate foundation. But when those statements arise from a ripe understanding that the word profession means more than a mere organized vocation for earning one's bread, it has a high and commendable meaning. The word profession "implies professed attainments in special knowledge, as distinguished from mere skill; a practical dealing with affairs, as distinguished from mere study or investigation; and an application of such knowledge to uses for others, as a vocation, as distinguished from its pursuit for one's own purposes." This sets the professional man in a position which demands from him an attitude of service and of leadership. He must have a masterly knowledge, in addition to skill in a vocation. He must deal practically in the affairs or needs of men. His duties must be performed with a touch of disinterested spirit in addition to the vocational spirit of earning his livelihood. Such men have a duty to the public; and in the performance of that duty they must exert their influence on that thought and practise of the day

[1] President's address of the American Institute of Electrical Engineers, delivered at the annual convention, Chicago, June 27, 1911.

which affects the welfare and progress of the nation. We as electrical engineers can not escape that duty, in case we wish to maintain the professional character of our occupation.

It may be retorted that questions relating to the welfare and progress of the nation are matters of economics and sociology, and not of engineering. The affirmation contained in this retort I will admit, but the negation I deny.

The theory of modern economics is built up under the influences produced by the introduction of steam power, with its potent agencies comprised in the steam railroad, ocean navigation and the use of steam power in industrial operations. These agencies are the creatures of engineers. Watt, Stephenson, Fulton, Ericsson, Boulton, Arkwright, Nasmyth, Bessemer, Siemens, Corliss, Holley and the other fathers of our modern industrial economic conditions were engineers; and it would be folly to deny to the parents an interest in their offspring, and equally folly to assert that the further developments of economic theory are not largely dependent on those industrial changes which are continually produced by the inventive activities of the great body of engineers. When I speak of industrial operations or industrial conditions, it must be understood that I include amongst industrial affairs the great means for transportation and intercommunication which are comprised in railways, telegraphs and telephones, in addition to the manufacture and distribution of products which involve the application of mechanical power as distinguished from animal power, and the manufacture, accompanied by distribution by pipe or wire, of the media for providing illumination and power. The engineers have precipitated these affairs on the world by their inventions; these affairs are in a large measure the support of the engineering profession; and it is the duty of engineers to do their share in molding their various economic creatures so that the creatures may reach the greatest practicable usefulness to society. In fact, it would show a cowardly weakness to suggest that this duty should be avoided by men who are essentially responsible, as the engineers are, for the existing conditions. Theologians and physicians can practise their professions aloof from the ordinary affairs of the world, but the engineers associated with industrial events can not. Moreover, such an avoidance of their duty by the engineers, even if avoidance of responsibility were possible, would be particularly unfortunate in view of the fact that the professed economists and sociologists apparently do not yet hold themselves subject to all the requirements of professional men, but still interpret their duties as being more confined to the field of study and investigation than to applying their knowledge to practical affairs.

It may again be retorted that the tenets which I am advocating will lead engineers out of a professional spirit and into "commercialism." It is worth while to pause here to reflect on that point. The word "commercialism" strictly means the characteristics of business or commercial life, but custom has made it applicable to any undue predominance of commercial ideas in a nation or community, and it has thereby come to infer a willingness to establish the strife for money in a position of precedence over reason and righteousness.

It has been alleged that learning loses of its dignity by becoming fashionable. It has also been alleged that learning loses of its dignity by becoming useful. Of the latter, at least, experience has proved the contrary—happily for engineers who are proud of their profession, for engineering

is necessarily an embodiment of the useful application of knowledge and learning. Engineering, relating, as it does, to the application of the powers of nature to useful purposes, must necessarily bring its followers into intimate contact with commercial affairs in an age when, as in ours, the industries dominate commerce, and the abatement of war has reduced the importance of military engineering. The tenets which I advocate do not tend to entangle the engineers in the depths of "commercialism" with which they may come in contact; but, on the contrary, those tenets propose that engineers should safeguard and nourish their professional spirit by assuming a part in public affairs in a spirit of disinterest, for the purpose of guiding the useful applications of natural forces to the greatest practicable service to society. A true engineer is a devoted follower after truth. He differs diametrically from the devotees of pure "commercialism," who are strictly opportunists. He also differs from pure idealists, who are often notable for refusing to accept any advance unless it wholly meets their personal ideals. The spirit of the engineer rejoices in obtaining any move toward the truth, but is always seeking farther advance. This characteristic spirit has been manifested in men of great achievement in many walks of life. It is a part of the life of such men as Martin Luther, Gladstone and Lincoln.

Those who accept even in part the usual evolutionary doctrines which are summed up by Herbert Spencer in his view that progress occurs by successive differentiations and integrations producing development from the homogeneous to definite, coherent heterogeneity, will assent to the proposition that the modern giant corporation follows in the wake of the one-man business and the simple partnership in response to an inextinguishable natural law. This is a case of natural selection. The progress of corporation development can not be prevented. It is one of the manifestations accompanying improved means of speedy transportation and inter-communication. Of the influence of the latter agencies, a learned and distinguished historian says, "Of all inventions, the alphabet and the printing press alone excepted, those inventions which abridge distance have done most for the civilization of our species. Every improvement of the means of locomotion benefits mankind morally and intellectually as well as materially. . . ." The possibility of, and indeed a necessity for, great corporate organizations came in the train of leading improvements in the means of locomotion and other beneficial inventions which abridge distance and subjugate time. Men of this age do not desire to relinquish the benefits of the improvements. We must, therefore, adjust our mental attitude to dealing properly with the situation; and in making the adjustment we must return to the old and approved recognition that a misdeed is a personal thing, and remember that responsibility for it can not be shifted from the personality of the man in responsibility to an impersonal aggregation entitled a corporation which he manages. In early days when English kings had great prerogatives in the government, and the doctrine of divine right, associated with the doctrine that the king can do no wrong, were still extant, the king was nevertheless limited to an administration of the affairs of the realm conducted, history tells us, in accordance with the laws, and, in case he broke those laws his advisers and agents were held responsible, and they were made personally answerable to the courts. History also indicates that this personal answerability of the advisers and agents had a tremendous influence on the conduct of

government and its relations to the public. In building up our industrial structure we must not overlook the plain guide board of history, and personal answerability must be established. But if we must establish personal answerability to the public, we must also establish fair and generous dealing by the public.

The building up of a great industrial nation in an honorable state of civilization is subject to many hazards—an error may cause injury to the structure that takes years or even decades to eradicate. It is, therefore, desirable to go cautiously and utilize the mature reflection of straight-thinking men who will give their thought to the subject. The forward route is untested, and real progress can be made only by judiciously combining teachings from the records of yesterday with experience of to-day to make a working theory for tomorrow. It has been suggested that a theorist should be defined as a man who thinks he may learn to swim by sitting on the bank and watching a frog. Doubtless, there are many such men in the world, but they are not theorists. The definition is as inaccurate as defining a black object as an object without color. Such men are only inexperienced, superficial or foolish. Theory, as the word is used by engineers, means a working hypothesis founded on all known facts and experience, which may be used to guide progress beyond the margin of past experience. Every successful, progressive man is a constant user of theory in this proper sense of the term. Every progressive step is made according to a theory of the man responsible for the move. Theory is not antagonistic to practise, but is founded on experience and is a guide to progress. Custom should be followed only when it has reason to support it. In the juncture now before us we must utilize the best theories of the corporation relations and the rights of persons and property, and cautiously extend our practises accordingly. No body of men are better equipped for this sound and scientific procedure than a body of professional engineers; and few others are so fully and adequately trained for such procedure as engineers, for the reason that this procedure is in accordance with the every-day steps of their business life. Moreover, the engineers of experience are well adapted to grapple with the mighty problems of a new age, for the reason that an efficient engineer must associate audacity and sobriety in his spirit.

If my premises are tenable, and I believe them to be incontestable, the engineers have a special duty, as professional men who are trained and experienced in straight thinking, to use their influence for the establishment and support of right and reason in the dealings between the public and the public service corporations. The problems surrounding the public service companies in American cities, and their relations to the citizens, should receive particular attention by members of our Institute, for those problems and those relations have been largely brought to their present importance and prominence through the activities of electrical engineers.

The public service corporations are the natural outcome of the demand of the civilized world for efficient and rapid transportation and intercommunication, and the concurrent need as communities become immersed in peaceful industrial pursuits for ample and conveniently provided supplies of water, gas and electric power. They compose a comparatively new and mighty force in the social organism and the organism must be adapted to efficiently utilize this force, but the force must be prevented from dominating or warping the organism. There is no danger of the public service corporations becoming des-

pots as some people seem to fear, provided they are put under proper restraints, but society cannot afford to make restraints which of themselves are unnecessary or unfair. These corporations serve a beneficial end in our life, and their rights are as well founded and should be as well secured and held sacred as the rights of any citizens who are individually or collectively bent on any proper business pursuits.

Some people seem to believe that all public-service corporation men are either wicked or are liars or thieves. This has as little foundation in fact as a belief that all men in Spain carry mandolins or that Spanish women always wear mantillas. If such unjust, superficial and improper opinions are to have influence in this nation, then only misfortune and woe can be the outcome. It is necessary for all men trained in straight thinking to combat such folly and to cry out for fair dealing, one with the other, as between the public-service corporations and the public which they are established to serve. No engineer does his duty who does not stand with fidelity for equally square treatment *for* as *by* these corporations. These corporations are not here as vampires on society, but are here to serve the needs of the people in a reasonable and business-like way; and their proper objects can not be accomplished unless they are treated with reason and established in confidence. They obtain their income from serving the public, and they can not give generous service unless they are granted generous opportunities. When under reasonable restraints and supervision, as by properly constituted public commissions, they are more quickly responsive to public sentiment than could reasonably be expected of any publicly owned business organization of equal magnitude which could exist under our political conditions, and their usefulness is proved beyond contradiction. Perhaps no man is more likely to observe these things than one whose professional practise, like that which has come to me, makes him retained adviser in some instances to public-service companies and in other instances to governments or municipalities, for he has to study fairness to each class of clients in all he does.

A barrier of distrust which exists between these servitors of the people and the people whom they serve is presumably due, on the one hand, to a memory by the public of misdeeds which were perpetrated before recent demands for reform brought about the establishment of adequate public supervision in prominent centers, and to a fear of the repetition of misdeeds where supervision and publicity have not yet been prescribed; and, on the other hand, to a certain reluctance by corporation managers to exhibit full and convincing frankness for fear that such frankness may be made the opportunity by unscrupulous politicians or persons with interested motives to crowd them to the verge of insolvency. These particular conditions of distrust could be obviated by means of the public itself owning the public-service properties and operating them in its own interest, but this is a drastic and undesirable alternative. Any fair-minded man of extended business experience who will study with unbiased intention the details of public ownership and public trading in the venerable and stable cities and states of continental Europe must be impressed with the reality that our inexpert and shifting governmental bodies are wholly unadapted to cope with such responsibilities, or to make an economic success equal on the average to that now accomplished by the privately managed service companies, whether the measure of success be taken on the basis of service provided for a unit of payment or

on any other reasonable basis of comparison.

If the public could feel sure of the ingenuousness of corporation statements and statistics, and the corporations could be protected from unfair attacks made by ignorant, although, in many instances, educated, persons or persons with ulterior motives, the barrier of distrust to which I have referred would be dissipated as dampness is dissipated by the rays of the sun; but this cure requires a long step forward in the average line of progress, for it demands a supervision of the companies which imposes on them exact and ingenuous bookkeeping associated with the presentation to the public of accurate and luminous statements of their business, and it equally demands that the public shall be required to yield justice to the companies with the same ample fullness as individuals seek it for themselves. A progressive step of this nature is always accomplished slowly and hesitatingly. I have observed in Macaulay's writings a paragraph which is graphic in illustration of our present situation. "Everywhere," he says, "there is a class of men who cling with fondness to whatever is ancient, and who, even when convinced by overpowering reasons that innovation would be beneficial, consent to it with many misgivings and forebodings. We find also everywhere another class of men, sanguine in hope, bold in speculation, always pressing forward, quick to discern the imperfections of whatever exists, disposed to think lightly of the risks and inconveniences which attend improvements, and disposed to give every change credit for being an improvement. In the sentiments of both classes there is something to approve. But of both, the best specimens will be found not far from the common frontier. The extreme section of one class consists of bigoted dotards: the extreme section of the other consists of shallow and reckless empirics."

The public, misled or annoyed by the reluctance of some honest but overcautious managements to make frank public statements of financial results and present convincing statistics of operation, enraged by the acts of a few adventurers who from time to time have secured a speculative hold in the public-service field, and enticed by the arguments of individuals with ulterior motives, are likely to follow the radical leadership of demagogues or of honest but false empirics. This is a danger which seriously exists in states where no public supervision of the service companies is provided, and also in a lesser degree in states where such supervision has been established. The danger must be rolled back by the exertions of fair-minded and right-thinking men. A serious menace to the welfare of the nation would be caused if unfair dealing toward the public-service companies were established as a policy. A scrupulously frank and honest dealing with the public by the companies should be insisted on, but the public must be taught the importance of dealing, on its part, with an equally scrupulous fairness and a well-balanced generosity. It is here that I say lies a duty of electrical engineers to the public. It is to give of their time and brain to convincingly establish the facts (the *facts*, I repeat) which the public do not understand in regard to the business of the public-service companies, to indicate the means for rightly treating these new influences which we and our fellow engineers have been creating by our works, and to aid in establishing measures which will favor and sustain mutual confidence and fair dealing between them and the public. This is an obscure and difficult problem on account of its touching the edge of men's ambitions and men's passions, and it seems

at times to possess the opacity and insolubility of a mill-stone; but looking persistently and with care into what appears to be a mill-stone not infrequently proves it to be composed of reasonably transparent material. The members of our institute should take somewhat to themselves as professional men this obscure and difficult problem, and aid in its solution as a matter of their duty to the public.

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TWENTY-FIVE YEARS OF OSMOTIC PRESSURE IN THE MEDICAL SCIENCES[1]

ON October 14, 1910, a large number of scientific men met in the lecture room of the Botanical Institute at the University of Utrecht, for the purpose of celebrating the twenty-fifth anniversary of Van't Hoff's theory of "osmotic pressure."[2] Professors Ernst Cohen and Hugo de Vries gave the principal addresses. The former, in his most inspiring and finished address, pointed out the invaluable services rendered by this great master to the science of chemistry.[3] Professor de Vries gave a lecture on vacuoles and on this occasion emphasized the importance of physical chemistry in general and particularly that of the theory of osmotic pressure for plant physiology.[4]

It would, I venture to say, amount to an unexplainable neglect, if the great body of medical investigators failed to give expression to the strong feeling of gratitude to this great scientist.

It gives me pleasure to present a brief account of the researches of de Vries and Van't Hoff and the indebtedness to them of the sciences referred to in the preceding.

In the first half of the last century it was already known that many substances have the power to attract water and also that this power was of great importance for the life of plants. In 1844, Mitscherlich made the first attempt to determine quantitatively this attraction. His figures, however, as well as those of later investigators, were by no means satisfactory.

As late as 1881 Pfeffer, in his text-book of plant physiology, deplores this fact and points out how important for the study of some of the phenomena of life it would be to know, even if only approximately, the water-attracting force acting in each and every substance contained in a plant cell.

It was in the year following (1882) that Pfeffer's hopes were fully realized by the great botanist Hugo de Vries, who actually solved the problem.[5] He employed three biological methods, of which the *plasmolytic* gave the most reliable results. This method consisted in employing a salt solution strong enough to bring about a slight separation of the contents of the plant cell from the cell membrane, in other words, to induce plasmolysis in the cell. Since this separation of protoplasts (plasmolysis) was due to the fact that the power of the surrounding fluid to attract water was somewhat greater than that of the cell contents, de Vries concluded that solutions of other

[1] Translated from the German by E. I. Werber, Baltimore, Md.

[2] J. H. Van't Hoff, "Lois de l'equibre chimique dans l'etat dilue, gazez on dissons," *Kongliza Swenska Vetenskaps-Akademiens Handlingar,* 21, No. 17, October 14, 1885.

[3] Ernst Cohen, "Een Kwart eew moderne Chemie," *Chemisch Weekblad,* No. 42, 1910 (Dutch); "Ein Vierteljahrhundert moderner Chemie," *Zeitschrift für Elektrochemie,* B. 16, No. 20, 1910.

[4] Hugo de Vries, "Vacuolen, Verhandl. v. h. Provincial Utrechtsch," *Genootschap van Kunsten en Wetenschappen,* 1910, p. 36.

[5] Hugo de Vries, Proces-Verbal der Konikl. Akad. von wetenschappen te Amsterdam, October 27, 1882; more exhaustively in *Pringsheims Jahrbücher f. wissensch. Botanik,* 14, 1884, p. 427.

salts causing the same degree of shrinkage when acting upon the same cell, must have a water attracting power of the same degree. DeVries called such solutions, *i. e.*, those having an equal water attracting force, *isotonic solutions;* and the simple relations, which appeared to exist between different concentrations of these solutions, he named the *isotonic coefficients.*

De Vries gave a lecture on these researches in the Amsterdam Academy of Sciences, and luckily had in his audience my late teacher and master, Professor Donders, who, as usually, came back to the laboratory in the afternoon. Donders was in the habit of discussing matters with me whenever a scientific problem attracted his particular interest. It was not, I think, that the great man wanted to hear the opinion of his assistant, but rather the fact that these discussions gave him an opportunity to formulate his thoughts and thus helped him to clarify the problem. Sometimes I could not help thinking that my master went a little too far in his thoughts, but this time everything was clear to me. He spoke about the lecture of de Vries to which he had listened a short while before and the question at once arose whether de Vries's findings for the plant cell would hold true for the animal cell.

I began work at once and it was the red blood corpuscles that I chose as my material. The first step was to find a concentration capable of inducing plasmolysis in these cells. But I failed to find it. No plasmolysis could be observed in my experiments. Then I turned to the study of escape of coloring material from the red blood corpuscles. And in the next year my teacher was able to report on my behalf the results of my investigations before the Amsterdam Academy of Sciences.[6] It was actually found that the red blood corpuscles were also subject to the law of isotonic coefficients. Between the concentrations of salt solutions causing the escape of coloring matter from the blood corpuscles the same numerical relation exists as between the concentrations of salt solutions inducing plasmolysis in the same plant cell. *These researches on the blood corpuscles (1883) marked the beginning of modern physico-chemical research in the medical sciences.*

It was repeatedly stated that Van't Hoff's theory of osmotic pressure laid the foundation for these investigations on the blood corpuscles, but this is decidedly a mistake.

The real basis for this work was given in de Vries's researches in plant physiology. These investigations and my own hæmatological researches furnished important data for an experimental proof of Van't Hoff's theory, which was based principally on thermodynamic considerations and on Pfeffer's findings and which was published for the first time two years later (1885). This historical accuracy, it is hoped, may not be regarded as an underestimation of the importance of Van't Hoff's theory for the medical sciences.

It is true that the physico-chemical researches in the medical sciences do not owe their origin to the influence of Van't Hoff's theory and that these researches were continued with success for almost a decade independently of the theory of osmotic pressure.[7] However, it must be strongly

[6] H. J. Hamburger, Proces-Verbal der Koninkl. Akademie van Wetenschappen te Amsterdam, December 29, 1883. German translation in *Festband der Biochemischen Zeitschrift,* H. J. Hamburger gewidmet zur Feier seiner vor 25 Jahren erfolgten Doktorpromotion, S. 1, 1908. Berlin, Julius Springer.

[7] To these belong among others the first determinations of the water attraction power (osmotic pressure) of the blood serum and other animal fluids by means of the study of the escape of the

emphasized that the influence which this theory exerted on the further development of physico-chemical research in medicine has become one of tremendous value. This will become clear from our further considerations.

But even during the decade referred to this theory exerted considerable influence. For some time after its appearance in its completed form (1887) this theory had a stimulating influence, however latent this may have been. Such terms as "water-attracting force" and "isotonic coefficients" no doubt served well the purpose of successful work, but their meaning was rather puzzling and their explanation by the new theory was received like a revelation. Furthermore, the theory of osmotic pressure with its more exact terminology and concepts helped much in shedding new light on what had been accomplished independently of it in the decade above mentioned.

It may well be asked why it was that relatively many years passed before Van't Hoff's theory came to be recognized in the medical literature. An explanation for this, I think, is given in the fact that the theory met with rather unfavorable criticism among the professional chemists[8] and also from the circumstance that the field of work opened up by the theory of isotonic coefficients was so large and the problems suggested by it so numerous that there actually was no time to take into consideration also the theory of osmotic pressure. Besides, for some time—we may well say, in the first ten years—little interest was shown in these new researches and accordingly the number of workers was very scarce. Indeed we were almost alone in our efforts.

However this may have been, that much at least is quite certain, that the theory of osmotic pressure announced in 1885 would not have achieved such great success, had it not been for *the fact that Van't Hoff was able to utilize Arrhenius's theory of electrolytic dissociation as a supplementary one to his own.*

Not infrequently one finds that there are very unclear and inexact notions about this rather intricate matter. It may, therefore, not be uninteresting to give an account of how it developed, using the original publication as a guide.

What was the actual situation?

According to Van't Hoff the dissolved substance, when in a diluted solution, behaves like a gas. He found that in such solutions the particles of the dissolved substance diffuse in their medium, and in this way exert a pressure on the walls of the dish. If a watery solution is made up in a dish, whose walls are semi-permeable, that is, impermeable to the medium of the

coloring matter from the blood corpuscles (1884) and the investigations on the concept of "physiological salt solutions," on the influence of CO_2, alkali and acids on blood; here belong also the investigations on lymph, resorption, etc.

[8] An illustration to this we may well see in the following incident:

The board of directors of the Deutsche Chemische Gesellschaft had in 1893 invited Van't Hoff to give a lecture on his physico-chemical researches.

In this lecture on January 8, 1894, Van't Hoff is said to have hesitated between two themes and made the following very significant remark: "On the other hand there was the theory of diluted solutions and osmotic pressure, but I preferred to leave the choice to the directors, *because I should not like to speak on a theme which may at present appear rather undesirable on account of the unfavorable criticism at the hands of professional colleagues, which we all highly esteem.* [Italics mine.] However, the directors chose the theory of solutions." (Cf. J. H. Van't Hoff, "Wie die Theorie der Lösungen entstand," *Ber. der Deutschen Chem. Gesellschaft,* XXVII., I., 1894, p. 6.)

This, then, was nine years after Van't Hoff's famous publication in the Swedish academy.

solution, and if this dish is put into water, the dissolved particles, in their futile efforts to diffuse into the surrounding solution, will cause a pressure. This pressure, which is perfectly analogous to the tension of a gas, Van't Hoff called osmotic pressure. According to Van't Hoff every molecule exerts the same pressure; in other words, solutions of an equal molecular concentration have the same osmotic pressure. This was also proved by experiment, *but only for substances belonging to the same category.* The values of osmotic pressure of substances belonging to different categories were compared, and showed considerable differences. *E. g.*, equimolecular solutions of sugar and salt showed an altogether different osmotic pressure. That of the NaCl solution was $1\frac{1}{2}$ times higher than an equimolecular solution of sugar.

This was the situation in 1885, when Van't Hoff published his theory. No wonder, therefore, that the theory could not be generally accepted.

It fell to Arrhenius's theory of electrolytic dissociation to explain away[9] the difficulty contained in Van't Hoff's theory. According to the Swedish investigator the salts in a watery solution, unlike sugar, dissociate partly into ions. To this Van't Hoff added the idea that each ion exerts the same osmotic pressure as would an undissociated molecule.[10] Accordingly the number of particles causing osmotic pressure is much larger in a salt solution than in an equimolecular sugar solution; in the above mentioned case it was $1\frac{1}{2}$ times as large. This explanation removed the obstacles of Van't Hoff's theory and *the isotonic coefficients of de Vries had now a clear meaning.*

It was now obvious that if the coefficients of NaCl and of sugar were 3 and 2, respectively, this was due to the fact that through the partial dissociation of NaCl into the ions Na and Cl, the number of water-attracting particles became $1\frac{1}{2}$ times larger than that of the sugar solution.

It is then not only to de Vries and Van't Hoff, but also to the great Swedish genius, that we owe a heavy debt of gratitude. This *not only because the theory of electrolytic dissociation forms a necessary supplement to Van't Hoff's original theory, but also because it has itself become of tremendous importance to the medical sciences.*

Without exaggeration, I think, we can apply what Wilhelm Ostwald said in this connection about chemistry, to the medical sciences: "Seldom has a lucky thought thrown so much light on so many and so difficult problems"; and in 1890, *i. e.*, three years after the theory of osmotic pressure has been known in its perfect form, Van't Hoff says of the theory of Arrhenius that "it has almost become a fact."

Quite inestimable has been the influence exerted by the de Vries-Van't Hoff-Arrhenius theory on our sciences. There is hardly a chapter in *physiology* that would not bear signs of this influence.

Nowhere has the application of the combined theory of the three great men been so intensive as in the physiology of the blood. This is easy to understand if we consider the fact that the blood corpuscles unlike most of the other cells can be kept

[9] Svante Arrhenius, "Ueber die Dissociation der in Wasser gelösten Stoffe," *Zeitschr. f. Physik. Chemie*, I., 630, 1887. Cf. also, Arrhenius, Behang till Kongl. Svenska Vet. Akad. Handlingaar, 8, No. 13 and 14, 1884.

[10] Van't Hoff, "Die Rolle des osmotischen Druckes in der Analogie zwischen Lösungen und Gasen," *Zeitschr. f. Physik. Chemie*, I., 481, 1887. He says here: ". . . Thus it may appear that to claim Avogadro's law for solutions as forcibly as I have done it here is rather unwarranted. However, my decision in this matter I owe to Arrhenius, who in a letter calls my attention to the probability that in the case of salt solution and the like we have to deal with a dissociation of ions."

isolated and uninjured for a relatively long time. Another advantage offered by the blood corpuscles is that the influence of diverse agents on their volume and form and likeness on their chemical and physico-chemical composition, can be studied with much exactness. Again it is possible, after causing moderate disturbances in the physiological equilibrium, to observe very accurately the exchange of particles between the blood corpuscles and their natural medium, the blood plasma. Furthermore, an excellent object is given in the white blood corpuscles and particularly in the *phagocytes* for the study of the effect of such disturbances on life.

To these researches belongs among others the study of *permeability* of different kinds of cells. This study was begun in 1889 as one of the results of the theory of isotonic coefficients. It was found that the blood corpuscles, despite the fact that their volume remains unchanged in an isotonic salt solution, are permeable to chlorine, if kept in the solution for a sufficiently long time. It is hardly necessary to point out how important the problem of permeability is. The permeability enables the cell to admit some substances into its interior and to refuse admittance to others. In this way the troublesome hypothesis of "conscious selection" of cells between certain substances is replaced by a simple fact of physics. To the pharmacologist this means that remedial agents have to be in a form which would make it easy for them to penetrate the interior of the cell body.

It may well be said that so long as physical and physico-chemical methods are employed in the study of the processes going on in living cells, the problem of permeability will play an important rôle in physiology as well as in pathology and in pharmacology.

Of course it must be expected, and many facts have already proved it, that owing to the high division of labor peculiar to the cells of our organism, the permeability to the same substance will be different with the different kinds of cells. So it is, for instance, a well known fact that the epithelium of the intestine is permeable to many substances, to which the epithelium of the urinary bladder is impermeable.

Another important discovery which we owe to physico-chemical researches was made in studying the formation and resorption of lymph. Attention was called here to *a driving force which must be accurately gauged* and which is based on the fact that a movement of water takes place from a place of low osmotic pressure to near-by places where this pressure is somewhat higher. This driving force is rather common, however, and is for instance always found to play a very important rôle whenever a large protein-molecule breaks up into smaller molecules.

Likewise it is the same driving force which, as Starling has shown, owing to the osmotic pressure of the albumen, is so important in connection with the resorption of fluids in serous cavities.

Of course, in the instances dealt with, the differences in osmotic pressure are low; they correspond to only a few thousandths of a degree of the lowering of the freezing point. However, it would be a mistake to think that this difference in the hydrostatic pressure is without influence to the organism. It must not be forgotten that one thousandth of a degree of the lowering of the freezing point would suffice to bring about a driving force of more than 0.1 m. of water pressure and that this pressure does not differ much from the one causing the flow of blood in the capillaries.

These modern researches were of not less importance, for the development of a new branch of science, namely that of *electro-*

chemistry, founded by Nernst on Arrhenius's theory of ions. It may well be expected that this new field of investigation will throw much light on problems, whenever electric currents are generated in the organism.

It has been but a few years since electrochemistry has found its application in the physiology of muscles and nerves. The automatic action of the heart as well as the electrical currents accompanying it will very likely find a physico-chemical explanation. These are only a few examples from the field of normal physiology.

Let us now see what was the influence of physical chemistry on other medical sciences.

Pathological physiology has gained by important discoveries on the chemical causes of disturbances in the circulation and the genesis of œdema. In *pharmacology* the great achievements in narcotics and disinfection are due in a large measure to physical chemistry.

Bacteriology and *histology* have also profited since by the study of permeability and the law of dissociation the nature of the process of staining came to be understood. We now know why it is that certain kinds of cells absorb some substances while others do not; and we also know why the medium of solution of a stain is of such importance in nuclear and bacterial stains.

Experimental embryology has gained much by a physico-chemical method of artificial parthenogenesis; and as for *practical medicine,* we may say that there is hardly a text-book or a handbook which does not show the influence of the theory of osmotic pressure. This influence may be found even in *surgery.* Examples of this are the intravenous and hypodermic infusion of the so-called physiological salt solutions and local anæsthesia.

We have attempted in the above to show, by few examples only, how great an influence the theory of isotonic coefficients and the closely related but exact theory of osmotic pressure and that of the electrolytic dissociation exerted on the medical sciences.

Also in an *indirect* way this theory proved extremely important. The brilliant results achieved by it in the last few years have been a stimulus for the application of other branches of physical chemistry to biological problems. It was, for instance, the chemistry of colloids and Van't Hoff's theory of chemical equilibrium and process of reaction that were soon taken up and which, making use of the concept of catalysis introduced by Wilhelm Ostwald, may aid us in understanding the mechanism of *enzyme action.*

To those who desire fuller information on what physical chemistry has given us in a short time, and to become familiar with the names of many of its workers I should recommend consulting some works treating exhaustively on this matter.[11]

It may well be asked how it came that physical chemistry had such brilliant results in our sciences. It is, I think, easy to find the answer to this if we only consider the specific methods of this science. These *unlike* the methods of *analytical chemistry* do not involve the use of strong

[11] Ernst Cohen, "Vorträge für Aerzte über Physikalische Chemie," 2. Aufl., 1907, Leipzig, Wilhelm Engelmann; R. Höber, "Physikalische Chemie der Zelle und Gewebe," 2. Aufl., 1906, Leipzig, Wilhelm Engelmann; von Koranyi und Richter, "Physikalische Chemie und Medizin," 2 Bände, 1907–08, Leipzig, Georg Thieme. Several articles in C. Oppenheimer's "Handbuch der Biochemie des Menschen und der Tierre," 1907 ff., Jena, Gustav Fischer; H. J. Hamburger, "Osmotischer Druck und Ionenlehre in den medizinischen Wissenschaften. Zugleich ein Handbuch physikalisch-chemischer Methoden," 3 Bände, 1902–1904, Wiesbaden, J. F. Bergemann.

bases and acids and life-destroying temperatures. On the contrary, the methods of physical chemistry are of such a nature as to make it possible to investigate the complete structure of many unstable substances of the organism, *in statu quo*, without modifying the changeable equilibrium of the often highly complex systems. This will insure to physical chemistry for an unlimited time to come a very important, and, I dare say, together with structural chemistry, a leading place in the medical sciences.

Far be it from me to underestimate the great achievements of other auxiliary sciences and methods of investigation in medical research. However, they can not lead us as far as does chemistry.

Let us, for example, consider the investigation of electric currents initiated by some physiological processes. No one, certainly, would maintain that the registration of these currents is the final aim of their investigation, even if this were done with faultless technique. Rather would not the question be raised, what chemical processes underlie the curves received by registration? Likewise, it is chemistry which we must expect to help us gain a deeper insight into the nature of and laws governing the processes of gland secretion.

Adapting an utterance of Mach, we may say: "The problems of nature resemble a manifoldly knotted thread, the course of which we can follow now from this and then from another loop which attracts our attention." There is no doubt that in future even more than now physical chemistry will furnish us the loop in our effort to disentangle many an intricate problem.

And the names of Hugo de Vries, Van't Hoff and Arrhenius will forever have a place of honor in the history of medical sciences.

H. J. HAMBURGER

GRONINGEN

THE COLLEGE MAN IN THE PUBLIC SERVICE

WITH the growth and development of the higher institutions of learning in the United States, the Federal service is attracting and securing an ever-increasing number of college-trained men. The civil-service act of 1883, providing for the gradual application of the competitive-examination method of selecting public officers and employees, opened the door of opportunity in the executive civil service to those whose merit appears from personal demonstration without reference to political affiliation.

With a better qualified personnel, measuring up to higher standards and guided by nobler ideals, there has been a marked increase in efficiency with greater dignity of service as a natural corollary. This marks the triumph of useful knowledge and discipline acquired in schools and colleges, a reminder that "wisdom is justified of her children" in the time and money spent in the cause of education.

It is hardly necessary to observe that the proper performance of the duties of a large number of employments in the public service does not require collegiate training. The lower grades are generally filled by those who have acquired at least the rudiments of education ordinarily obtained in the public schools, and not a few positions are filled by those who have had the advantages of training in special courses for skilled occupations.

Broadly stated, the largest sphere of usefulness in the public service for the college-trained man is found in the military, administrative, and technical offices of the executive branch of the federal government, as well as in legislative and judicial offices.

Positions in the military service, being filled principally by graduates of the government collegiate institutions at West Point and Annapolis, offer careers to comparatively few graduates of other schools. However, there are opportunities for appointment to some places in the military and naval services through competitive examinations held by the respective departments. Among these may be

mentioned positions in the medical corps of the army and of the navy, civil engineers in the engineer corps of the army, assistant naval constructors in the navy, second lieutenants in the army and in the marine corps. The war department has at the present time about one hundred and fifty vacancies in the cavalry, field artillery, and infantry branches of the army that are to be filled from civil life after preference has been given to enlisted men capable of passing the tests required for promotion from the ranks. To secure nomination for a commission in the army a civilian must pass (1) a preliminary mental examination, (2) a physical test, and (3) a final mental examination. Graduates of "recognized" colleges or universities or of institutions of learning at which officers of the army are detailed as professors of military science and tactics of a certain standard, are not required to take the preliminary mental test, and upon passing the physical test and the final mental examination "honor" graduates of such institutions receive preference in appointment. An examination is now in course of preparation by the war department to fill from civil life ten places of civil engineer in the engineer corps of the army. The United States Public Health and Marine Hospital Service offers a career to graduates in medicine who can pass the examination prescribed by the service. The diplomatic and consular services have recently been placed, by act of congress and executive order, on a higher plane and made more permanent in character. Entrance to either service is through examination, and vacancies in the more important posts are filled by those who demonstrate ability in the lower-salaried offices. The entrance examination is searching and includes collegiate work. All appointees to these positions in the various services mentioned are commissioned by the President of the United States.

Public confidence in the worth of college training is seen in the choice, through the elective franchise, of members of congress, of whom nearly one half are college graduates. What was said upon this subject some years ago by Dr. Garfield, then of Princeton University, can be said with even greater truth to-day: "The educated man has no better claim on the suffrages of the people than the uneducated, so long as there are both trained and untrained bodies of men in the community, for this is government by the people; but the educated man, exercising his power as a creator of sound public opinion, occupies a position from which he can not be driven by the machinations of the politician and to which men of purely practical political experience can not be appointed or elected." It is scarcely necessary to add that a majority of the justices and judges in the federal judiciary are men of collegiate training.

Owing to the number and variety of administrative and technical offices in the executive branch of the public service, the university-trained man has a wide field for selection, and the high degree of ability or technical training required offers careers in the civil service often more purely professional and not less dignified or useful, even though sometimes inadequately compensated, than a legislative, judicial or military career.

With respect to administrative officers, including secretaries and assistant secretaries of departments, commissioners, heads of bureaus, and other subordinate officers, men with college training are usually selected for appointment. Promotion of meritorious subordinate officials to administrative offices is not by any means so rare nowadays as it was in former years. There are hundreds of civil administrative officials who, having entered the service in subordinate capacities and demonstrated their ability, have been advanced to more responsible positions on their record. The recognition of merit creates a healthy ambition on the part of subordinates to excel in the performance of their duties and thus to win promotion.

It is in the field of applied science, however, that the demand for university training is imperative and where the personnel of the service is almost wholly composed of college men. Washington is not only the seat of government but also the abode of learning,

especially that learning which is acquired by research and original investigation. Of two thousand leading scientific men mentioned in "American Men of Science," by Professor Cattell, two hundred and twenty, or eleven per cent., reside in Washington, a percentage exceeded only in the states of Massachusetts and New York. President Jordan, of Stanford University, himself formerly engaged by the United States for scientific work, in an article on the establishment of a national university, says: "The scholars and investigators now maintained at Washington exert an influence far beyond that of their official position." A very large body of university-trained men in Washington are devoting themselves to study and experimentation, endeavoring to gain concrete knowledge that may be applied to the development of the country's resources. A writer in *The Outlook* of July 24, 1909, upon the subject, "Patriots in the Public Service," paid a graceful and well deserved tribute to the ability and patriotic devotion of the scientists who labor in the federal service. "There is no class of men," he says, "who contribute so directly and on so large a scale to the welfare, progress and wealth of the whole people as do the scientists of the federal government. This is due to their exceptional ability, to their *esprit de corps,* the watchword of which is disinterested service, and to the position of vantage and influence which their official status gives them."

Governmental activity along lines of applied science has reached huge proportions. Thousands of scientists, scores of laboratories and an annual expenditure of a hundred million dollars but inadequately express the magnitude of governmental enterprise in this direction. The current appropriations for the Department of Agriculture alone are over twenty millions of dollars, and investigation is going on in every field where systematized knowledge can aid in the conservation of resources, in the multiplication of products, or in the solution of economic problems of the rural community.

Some of the activities of bureaus of the Department of Agriculture are indicated in the following:[1]

Weather Bureau: meteorology.

Bureau of Animal Industry: pathology, zoology, biochemistry.

Bureau of Plant Industry: plant physiology and pathology, pomology, horticulture.

Forest Service: dendrology, silviculture, utilization of wood products.

Bureau of Chemistry: investigations and analyses of fertilizers, agricultural products, foods, drugs, etc.

Bureau of Soils: analytic, fertility and soil-water investigations.

Bureau of Entomology.

Bureau of Biological Survey.

Office of Experiment Stations: nutrition, irrigation and drainage investigations.

Office of Public Roads: chemistry, petrography, scientific road construction.

Among the bureaus and offices of other departments engaging in work of a scientific or technical character are:[1]

Treasury Department:

Public Health and Marine-Hospital Service, with its Hygienic Laboratory: medicine and surgery, chemistry, pharmacology, zoology, sanitation.

Supervising Architect's Office: employing architects, civil engineers, etc.

Bureau of the Mint: coining and assaying, involving chemistry, metallurgy, etc.

Navy Department:

Naval Observatory: astronomy and mathematics.

Hydrographic Office: hydrography and cartography.

Interior Department:

Geological Survey: geology, paleontology, chemistry.

Bureau of Mines: physics, chemistry, mining, metallurgy.

Patent Office: investigations in almost every branch of applied science.

Reclamation Service: civil engineering.

Government Hospital for the Insane: mental diseases.

[1] This abridged reference to bureaus and offices and their activities is merely suggestive and is not intended to be a complete or detailed enumeration of all bureaus and offices doing scientific or technical work, of their functions or of the sciences involved.

Department of Commerce and Labor:

Bureau of Standards: physical and chemical investigations.

Coast and Geodetic Survey: geodesy.

Bureau of Fisheries: aquatic biology and physics, oceanography, applied ichthyology, utilization of water products.

Bureaus of the Census, of Statistics and of Labor: statistics, social and economic subjects.

Lighthouse Service: civil engineering.

Smithsonian Institution and National Museum: natural sciences.

Several bureaus of the different departments are engaged in technical work involving civil, electrical and mechanical engineering.

The headquarters at Washington serve as a training school in some of the bureaus which have field services. Employees are trained in the central office before being sent out to field stations. In other bureaus employees gather material in the field during the summer months and in the winter return to Washington to prepare the material for study and publication.

If salaries of scientists and experts in the public service are in general somewhat inadequate considering the education required and the scholastic nature of the duties involved, there are compensatory advantages which must not be overlooked in comparing a career in the public service with a career in private life. The government is liberal in furnishing adequate equipment in the way of laboratories and libraries to carry on its research work. Notable libraries and laboratories are the Libraries of Congress, the Department of Agriculture, the Bureau of Education and the Surgeon General's Office in the War Department; the law libraries of the Supreme Court and the Department of Justice; the laboratories of the Bureau of Standards, the Department of Agriculture, the Bureau of Mines and the Hygienic Laboratory and the laboratory of the Army Medical Museum.

While men of exceptional attainments in special lines, employed as collaborators and experts, are often given a monetary compensation far below what they might receive in private employment, they gain the prestige following their selection by the government as recognized authorities, and, also, the opportunity to follow out, with ample assistance and equipment, various lines of investigation of great ultimate benefit to the people. Young college men, with the capacity for original work, and with a thorough foundation of theoretical knowledge, find encouragement to pursue the practical side of science.

Industrial organizations demand men trained in applied science. The government service not only offers opportunity for advancement, but is also used by private employers of technical skill as a hunting ground and source of supply. Many opportunities are given experts in the different bureaus to enter university or commercial positions, often at salaries more than double their government compensation. In consequence, resignations from the higher offices are comparatively frequent, promotions follow, and the resulting vacancy in the lowest grade is filled by appointment through competitive examination.

Many clubs and associations furnish opportunities for the exchange and diffusion of ideas. The Cosmos Club, the National Geographic Society, and the Washington Academy of Sciences may be mentioned as examples, and many branches of science have their corresponding societies. The Carnegie Institution for research, though a private foundation, has given additional importance to Washington as a center of learning. With so large a number of eminent scientists working under favorable conditions and the stimulation derived from social intercourse and exchange of thought, an unusual environment and atmosphere, at once healthful and helpful, are created and sustained.

The college man in the public service is today essential to the maintenance of efficient and economical administration, and he should enter it with as much assurance of an honorable career as do the British who enter their home or foreign services. The college man's training has been systematic; he has been taught to recognize fundamental principles; he has learned to reason, to coordinate, to concentrate all of his powers upon the subject in question. When he enters the service

his education is still incomplete, but he brings with him an ordered mind which makes easier his own path and that of his superiors, for he is quick to grasp essentials and to reach results. He outstrips his less favored brother who lacks the training and discipline of the college or university; and the fact that occasionally there are to be met splendid examples of practical intelligence and energy whose training has been obtained in the world's hard school of experience and not within academic walls does not in the least lessen the force of the contention in favor of the college-trained man's availability.

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CONCERNING BOTANICAL INVESTIGATION IN COLLEGES

DURING the last two or three years several articles have appeared in SCIENCE which have had to do wholly or in part with scientific investigation in colleges. As a college teacher the writer has read these with interest. He is just entering upon his twentieth year as a college teacher and has, during two decades of experience with college students, reached certain conclusions concerning this subject, especially in so far as it relates to his own subject—botany. It is not believed that botanical science differs greatly from other sciences with respect to investigation, but it has seemed best to the writer to confine his statements to the science which he is teaching.

Every teacher of botany should be an investigator. The spirit of investigation, which appears in the normal person in early childhood, should never be stifled in one who is to teach botany or who is teaching that science. When the teacher of botany ceases to be an investigator he should retire. His investigation should extend at least to the plant life about him and to the literature directly or indirectly relating to his teaching. Some botanists fear that this spirit of investigation will, if carried further, interfere with teaching in college. The writer pleads guilty of seeing 100,000 titles in a single year in search of matter that might aid in his teaching and in the advancement of botanical science, recording some titles for future use, and examining others minutely. At the same time he was carrying forward some laboratory in-

vestigation; and he was conscious every time he came back to the classroom from his private laboratory or from the library that he was better fitted for his work and had a keener relish for it. For some teachers investigation is as much a tonic as is a pleasure trip or the round of social enjoyment for others.

Whether the teacher's investigation should extend far beyond the field of his teaching is a question for each one to consider for himself. Certainly the college teacher of botany may well include in his investigation many things which will probably never be used in the classroom, but which round out his knowledge of his subject, make him a better teacher, and may be drawn upon if needed. But his investigation should be secondary to his teaching and should be closely enough connected with it, at least in its initial stages, so that some of the facts ascertained may bear directly on the teaching. But if he be an investigator in the best sense, he will eventually push his investigation to the limits of human knowledge in some direction. His investigation now becomes real research. The question now is whether he shall continue or stop. He certainly should do the latter if he does not regard his research of considerable human interest and if his enthusiasm for such isolated investigation does not make it a pleasure rather than a burden for part of his spare hours. If he has this faith in the value of his work and his enthusiasm inspires him to continue, the institution for which he works can afford to lighten his burden somewhat, if possible, for the benefit that such example will have on other teachers and on students in encouraging them to scholarly attainment. Some kinds of research can be carried forward on two or three hours' work each day; and the teacher can easily learn to drop his research and go to his students refreshed and the more ready to work with them because of the keen mental gymnastics connected with his own laborious study, the teaching by its different and disconnected nature seeming like a diversion. The man of strong body and active mind can carry the investigation forward and still keep abreast his profession as a teacher.

The teaching being of prime importance, the college teacher's botanical investigation should never be required to be done at a given time, and he should be free to drop it for a day, a week or a month whenever his teaching requires all of his time. Teaching is an aid to research, and research is an aid to teaching; and there are lines of research that touch college teaching as well as university teaching. The university teacher may make research his main work; the college teacher should never. No college teacher should be chosen or retained mainly on account of his ability as an investigator, but encouraging a college teacher in a limited amount of research is a different matter. No science stimulates to investigation and research more than botany, and the college teacher of this science who is not an investigator is scarcely worthy of the profession.

But what of botanical investigation by the college student? No college student should be thrown on his own resources in investigation to the exclusion of regular instruction after two or three years of botanical study. The student is too narrow at this time and will remain so if he begins to give much of his time to investigation. But the writer believes that some young people should begin specialization in the late teens and that in rare instances a part of this specialization may well be investigation, even for the undergraduate student. And why not? We often start the child at music as early as five or six years, but we too commonly attempt to thwart the desire of the youth for investigation until the last bit of enthusiasm and initiative is crushed. Some would smother it in the brightest and best prepared undergraduate and expect it to burst into a living flame soon after the student reaches the university. The rare undergraduate who has the desire, ability and time for investigation of some definite botanical problem and who has a teacher who can not or will not encourage and direct him is unfortunate. It is a misfortune that some college teachers of botany are not investiga-

tors and can not direct such students. On the other hand, it is fortunate for the college teacher that very few of the students in our classes are ready to attempt special problems.

Even after many years of experience, the writer does not think that he should attempt to direct more than two or three of his students in special investigation at one time. These he tries to select early in the courses in botany and to suggest something to them which may be carried along for a time with their regular work and take more of their time as they advance, the investigation sometimes being finished under his direction after they have graduated. Every advanced student of botany might well be expected to do seminar work, but few teachers can find time to direct all advanced students properly even in this. The writer has a senior college student who has been working on a special problem for two years and who spent the whole of last summer in laboratory investigation and library work, in matter related to this problem and others similar to it, without credit on his course. This student has gone through about 40,000 titles in search of literature pertaining to this work and is aiding his teacher in perfecting his lectures on the subject, and in putting them together in systematic fashion. The student is by no means narrow in his botanical training, nor is he regarded narrow as a college student.

Independence and originality should be encouraged, and why should we discourage the exceptional student when he reaches the point where he wants to attempt some independent work? The effort may or may not result in something worth publishing, and if published, it should not be tabooed because done by an undergraduate student. Some of the best research is done by those who have had no college or university work. So far as they go, the results obtained by undergraduates are sometimes equal to those of graduate students who undertake more difficult problems. Like the teacher's research, the student's investigation should center about some problem related to his undergraduate courses and his proposed life work. There are many problems of this kind. Some of them are work on some portion of a local or a state flora, investigation of some plant disease, the study of the woodlots of a small area adjacent to the college, the working out of keys for the identification of certain fungi or other plants of the region, the investigation of botanical instruction in high schools or colleges, studies in laboratory administration, etc. These and many other problems may well be attempted by the exceptional undergraduate, provided his teacher has sufficient insight and enthusiasm to aid him when he needs help.

Lest the drift of the argument above may have obscured the writer's views somewhat, it needs to be repeated in closing that the investigation of the undergraduate should never exclude thorough and broad botanical training, nor should it replace a knowledge of the elements of many subjects in the college curriculum. Hence it must be confined to the rare student, who is especially fitted and has time for this work and the more important general work which will give him a broad mental training.

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THE "KAISER-WILHELM INSTITUT FUR PHYSIKALISCHE CHEMIE UND ELEKTROCHEMIE"

On October 1 Professor F. Haber will begin his work as director of the new Kaiser-Wilhelm Institut für physikalische Chemie und Elektrochemie at Dahlem near Berlin. The buildings of the Institut, work upon which was begun during the present summer, are being erected by the Prussian government working in conjunction with the "Koppel-Stiftung for the purpose of improving the intellectual relations of Germany with other lands."

The "Koppel-Stiftung" which was founded in Berlin some years ago by Geheimer Kommerzienrat Leopold Koppel, and which until now has maintained the German School of Medicine in Shanghai and the American Institute in Berlin, will provide the funds for

the erection of the new institute and will also give thirty-five thousand Marks annually for its maintenance during a period of ten years. The Prussian government has provided the site which is situated at the terminus of the new underground railway from the center of Berlin to Dahlem, and has endowed the institute with the sum of fifty thousand Marks annually.

The institute will be controlled by a board consisting of two representatives of the German government, two representatives of the Koppel-Stiftung and the director of the institute. The director has an absolutely free hand in the choice of his work, his fellow workers and his assistants. For the admission of investigators who wish to follow their own lines of investigation in the institute with their own means, the director must have the assent of the board of control.

The institute will consist of scientific and technical departments in separate buildings. The building of the scientific department is 600 square meters in ground area, and has a basement entirely underground, containing constant temperature rooms. On the ground floor are the professor's laboratory and consulting room, the offices, the calibrating room in which are to be kept the necessary laboratory standards, the mechanic's workshop and a lecture theater to seat twenty-five persons. Further lecture rooms are not provided in the building as *teaching in the ordinary sense is not contemplated in the institute.* The first floor will be devoted to the library, chief assistant's room, glass blowing room and a laboratory for eight research men. On the second floor are the living rooms for the mechanic and his family, since the mechanic also acts as caretaker. This floor also contains rooms for photo-chemistry, for scientific collections and work places for several more research workers.

The building is connected by a corridor with the technical department, whose most important feature is the machinery hall with a floor space of two hundred square meters. This hall is surrounded by smaller rooms for chemical preparations, high voltage and heavy current work and a blacksmith shop. The ground floor of the technical building contains a consultation room and the laboratory of the assistant in charge of that department. On the first floor are the living accommodations for two assistants and an engine-man and also a room for the serving of refreshments.

The director's house will be erected in the grounds of the institute.

Although there exists no stipulation on the point, *it may be taken as a rule that, on account of the fact that no teaching as such is to be undertaken, only such students will be admitted by the director as have already finished their normal university course and desire a wider experience in scientific research.* This will mean that students who come directly from American universities should have the degree of doctor of philosophy in chemistry, or physics, or an equivalent training. There are no restrictions whatever as to the nationality of the men admitted by the director.

The director of the institute, Professor Haber, was born in Breslau in 1868, and obtained his Ph.D. in Berlin in 1891. After obtaining his degree he spent several years, partly in technical work and partly in securing further scientific training. In 1894 he went to Karlsruhe and was appointed privat-dozent in chemical technology in 1896 and ausserordentlicher professor in 1898. In 1902 he was sent to America by the Bunsen Society of Applied Physical Chemistry to study the system of chemical instruction and the condition of electrochemical industries in the United States. In 1906 he was appointed to the post of ordentlicher professor in physical and electrochemistry in Karlsruhe, where he built up the best equipped research laboratory of physical chemistry in the world. Students from all parts of the world were attracted to this laboratory to such an extent that its accommodations were insufficient to allow all of them to enter, even although Professor Haber admitted as many as forty men at one time as research workers. What was most remarkable was that he personally directed the work of all of these men, and often aided them in their experimental work. In 1907 he was called to

take the place of Lunge in Zurich as professor of chemical technology and in 1909 he was asked to undertake the control of one of the largest chemical works in Germany, but he declined both of these appointments.

Professor Haber introduced into Germany the rational method of instruction in elementary chemistry as embodied in the laboratory outline written by Alexander Smith. This book was translated into German by Professor Haber and Fritz Hiller. The two books: 1898, "Lehrbuch der technischen Elektrochemie auf wissenschaftlicher Grundlage" (now out of print); 1905, "Thermodynamik technischer Gasreaktionen" (English edition, 1908), together with numerous contributions to the *Zeitschrift für Elektrochemie, Wiedemann's Annalen* and the *Zeitschrift für physikalische Chemie,* constitute his literary activities.

One of Professor Haber's most important researches was that upon the ammonia gas equilibrium at high temperatures. This work resulted in the development of a commercial method for the manufacture of pure ammonia directly from the elements by the use of osmium or uranium as a catalyzer. Another important series of researches was that upon the properties of flames, including the gas equilibria involved, the ionization and conductivity of the gases and the action of the ions as catalyzers. He has spent much time during the last few years upon the study of the escape of electrons from the reacting surfaces of metals and the effects of electrons upon gas equilibria and upon the velocity of chemical reactions. His other recent researches have been mostly upon the following subjects: the electromotive force of the oxyhydrogen cell at high temperatures; the oxidation of nitrogen in the high potential arc; a gas refractometer for the optical analysis of gases, according to Rayleigh's principle; electrical forces at phase boundaries; the corrosion of iron by stray currents from street railways; the reduction of hydroxylamine; the use of solid materials such as glass and porcelain as electrolytes; the equilibrium between magnesium chloride and oxygen; electrode potentials and electrolytic reduction; the laboratory preparation of aluminium; the preparation of hydrogen peroxide by electrolysis; experiments on the decompositions and combustion of the hydrocarbons, and autoxidation.

The writer wishes to thank Dr. Fritz Hiller, of Berlin, for the greater part of the information contained in this article. The statements in regard to the purposes and government of the institute are official.

WILLIAM D. HARKINS
UNIVERSITY OF MONTANA,
September 30, 1911

THE GENERAL EDUCATION BOARD

CONDITIONAL appropriations aggregating $635,000 have been granted to six colleges and universities by the board of trustees of the General Education Board. Applications from twenty-four institutions were presented. From this list the board selected six among which is distributed conditionally the available funds as follows:

To Bucknell University, Lewisburg, Pa., $35,000 towards $160,000; to Earlham College, Richmond, Ind., $75,000 towards $400,000; to Furman University, Greenville, S. C., $25,000 towards $100,000; to Grinnell College, Grinnell, Ia., $100,000 towards $500,000; to Smith College, $200,000 towards $1,000,000; to Southern Methodist University, Dallas, Tex., $200,000 towards $1,000,000.

During the meeting attention was called to the fact that since Mr. Rockefeller made his first contribution to the board for the promotion of higher education, contributions have been made to ninety-one institutions in an aggregate amount of $7,625,000 towards a total of $35,909,512. Fifty-one institutions to which the board has made conditional contributions have completed the subscriptions for the supplemental sums required and to these institutions the board has already paid $3,500,000 in cash. It was pointed out that as a result of the campaigns made by these fifty-one institutions their assets have been increased by over $19,000,000. Their student bodies have increased by 2,047, 183 new professors have

been employed and the annual payment to professors in these fifty-one institutions has been increased $421,712.

A further statement by the board showed that it is now paying the salary and traveling expenses at twelve of the state universities of the southern states of professors of secondary education engaged in promoting the establishment of public high schools. Since the beginning of this work, five years ago, 912 new public high schools have been established in the southern states; 824 teachers have been added to the schools which were already in existence, 656 new public high school buildings have been constructed at a cost of $9,000,000, and the funds for the annual support of high schools have been increased by $1,688,894.

The board has contributed between $600,000 and $700,000 to forty-one schools for negroes.

The board's statement calls attention to its work in helping to fight the boll weevil by farm demonstration in southern states. It has contributed $400,000 for this purpose. The Department of Agriculture took over the work in some of the states so that the work of the general education board is now limited to Maryland, Virginia, North Carolina, South Carolina and Georgia. The salaries and expenses of 219 agents are paid by the board. These men are conducting demonstrations on 20,000 farms. They have also organized boys' corn clubs with a present membership of 50,000 and girls' canning and poultry clubs with a rapidly growing membership.

SCIENTIFIC NOTES AND NEWS

Dr. W. H. Emmons, of the University of Chicago, has been elected director of the Minnesota State Geological Survey, as well as professor in the university.

Professor J. G. Lipman has been made director of the experiment station and of the college farm at Rutgers College.

Rev. Joel H. Metcalf has moved his observatory to Winchester, Mass., eight miles from Boston, where he expects to renew his work of photographing asteroids.

Dr. Richard Dedekind, professor of mathematics in the Technical School at Brunswick, has celebrated his eightieth birthday.

At the Lister Institute Drs. E. E. Atkin and W. Ray have been appointed to be assistant bacteriologists, Mr. A. W. Bacot to be entomologist and Dr. Casimir Funk to be a research scholar.

Professor R. H. Tucker, astronomer at the Lick Observatory, has returned to Mt. Hamilton after three years leave of absence. He has been in charge of the astronomical expedition to Argentina, under the auspices of the Carnegie Institution.

Dr. and Mrs. Charles W. Eliot intend to sail from this country on November 7 on a trip around the world to last about eight months.

Dr. R. R. Gates expects to sail for Europe on November 3, to carry on investigations during the winter in the botanical laboratories at the Royal College of Science, London.

A complimentary dinner was given on October 26 by the instructing staff of the Massachusetts Institute of Technology to meet the three professors who have retired this year from active work at the institute. These are Gaetano Lanza, professor of theoretical and applied mechanics; Peter Schwamb, professor of machine design, and Francis W. Chandler, professor of architecture.

Dr. N. C. Ricker, professor of architecture, and Professor I. O. Baker, in charge of the department of civil engineering of the University of Illinois, have been appointed by Governor Deneen as members of the commission to revise and codify the building laws of the state of Illinois, which commission was authorized by the last general assembly of the state. The other members of the commission are Mr. R. E. Schmidt, Mr. W. C. Armstrong and Mr. W. S. Stahl, of Chicago; Mr. W. H. Merrill, of Lake Forest, and Mr. G. J. Jobst, of Peoria. Dr. Ricker is chairman of the commission.

Dean C. B. Connelley, of the School of Applied Industries of the Carnegie Technical Schools, has been appointed a member of the

new Pittsburgh Board of Public Education, which, under the new school code of the state, assumes control of the educational system of the city on November 13.

THE "Rôle of the Salts in the Preservation of Life" was the subject of the Wesley M. Carpenter lecture, delivered at the New York Academy of Medicine on October 19, by Jacques Loeb, M.D., Ph.D., Sc.D., of the Rockefeller Institute.

ETHER day was observed October 16 at the Massachusetts General Hospital in Boston by the usual clinics and luncheon. In the afternoon Dr. Simon Flexner gave an address on "The Biologic Basis of Specific Therapy." The alumni met for a banquet in the evening and were addressed by Drs. Simon Flexner, New York City; Charles F. Stokes, Surgeon-General U. S. Army, and Harvey Cushing, Baltimore, who is to be in charge of the surgical side of the new Peter Bent Brigham Hospital, now in process of construction.

A COURSE of six lectures will be given by Professor Franz Cumont, of Brussels, on "Astrology and Religion," at the University of Pennsylvania at 4 P.M. on the following days:

Monday, October 30—The Chaldeans.

Thursday, November 2—Babylonia and Greece.

Monday, November 6—Dissemination of Astrology in the West.

Thursday, November 9—Astral Theology.

Monday, November 13—Astral Mysticism; Ethics and Cult.

Thursday, November 16—Astral Doctrine of the Future Life.

THE twenty-ninth annual congress of the American Ornithologists' Union will convene in Philadelphia, on November 13, at 8 P.M. The evening session will be devoted to the election of officers and the transaction of other routine business. The meetings, which are open to the public and devoted to the reading and discussion of scientific papers, will be held in the lecture hall of the Academy of Natural Sciences, 19th and Race Sts. (Logan Square), commencing on Tuesday, November 14, and continuing for three days. Information regarding the congress can be had by addressing the secretary, Mr. John H. Sage, Portland, Conn.

THE British government is sending out a further commission to central Africa in connection with sleeping sickness. This will be in charge of Colonel Sir David Bruce, who will be accompanied by Lady Bruce and assisted by Captain Hamerton, R.A.M.C., Professor Newstead, of the Liverpool School of Tropical Medicine, Major Harvey, R.A.M.C., Staff Sergeant Gibbons and Mr. James Wilson. The work of the commission will on this occasion be confined to Nyasaland, where over 40 cases of sleeping sickness have occurred since 1909. The commission, which is also under the auspices of the Royal Society, is expected to be absent from England for three years. Sir David and Lady Bruce and the other members will leave Marseilles on November 10, and will proceed up the Zambesi and the Shire rivers to Blantyre and Zomba, the capital of Nyasaland.

THE London *Times* states that Mme. Curie has asked M. Nenot, the architect of the "Radium Palace," which is being built on the site of a former convent in the Rue Saint Jacques, to add to it a laboratory for purposes of instruction. M. Nenot, who is official architect to the Sorbonne, has replied that the additional building would entail an expenditure of £1,600, and that he will ask the University of Paris to authorize its construction.

LECTURES before the Royal Geographical Society will be given as follows:

November 6—The Norsemen in America, by Dr. Fridtjof Nansen.

November 20—Volcanic Craters and Explosions, by Dr. Tempest Anderson.

December 4—The Geography and Economic Development of British Central Africa, by Sir Alfred Sharpe.

December 18—American Deserts, by Dr. T. McDougal.

AT the occasion of the two hundredth anniversary of M. V. Lomonosov, the Academy of Sciences of St. Petersburg founded the "Lomonosov Institute" for investigations in physics, chemistry and geology. A building

site has been provided by the city of St. Petersburg.

PROFESSOR FLORENTINO AMEGHINO, the well-known paleontologist and director of the Museo Nacional in Buenos Aires, died on August 6 at La Plata, at the age of fifty-six years.

DR. JOSEPH BELL, a distinguished Edinburgh surgeon, has died at the age of seventy-four years.

M. LOUIS-JOSEPH TROOST, the eminent French chemist, has died, aged eighty-five years.

A MONUMENT to Michael Servetus was unveiled at Vienne in Dauphiné, where he resided as the medical attendant of the Archbishop Paul Paulmier from 1541 to 1553. According to the London *Times* the monument represents the burning of Servetus at the stake (October 27, 1553). He stands in the midst of the faggots chained to a stone with his book of theological tracts tied to his girdle. On his head is a wreath of leaves covered with brimstone. The representative of the University of Paris, Professor Charles Richet, spoke of the discovery by Servetus of the pulmonary circulation of the blood as marvellous and as *prolem sine matre creatam* since Servetus, unlike Harvey, had not practised vivisection, nor had he proceeded by a complete inductive study of anatomy. His contemporaries could not appreciate his discovery; it was not immediately followed up, and seventy-five years elapsed before it was scientifically established by Harvey. Professor Rudolf Berger, of Berlin, deposited a wreath on the pedestal of the monument in the name of "democratic and liberal Germany." M. Édouard Montet, rector of the University of Geneva, was one of those who spoke of the intolerance of the sixteenth century, and of Calvin's share in the prosecution and condemnation of Servetus. He characterized Servetus as "that Spaniard of genius with the encyclopedic mind," and said that his name had become the symbol of modern toleration. M. Ferdinand Buisson, one of the deputies for the Seine department, described Servetus as having "maintained with sublime simplicity against the pope of Rome and the pope of Geneva the right of free thought and the right to be the servant of his conscience and his reason alone."

THE members of the syndicate appointed to consider the provision of pensions for professors and others in the service of the University of Cambridge have issued their report. According to the abstract in the London *Times* they say that while they can not recommend a contributory scheme they propose that the university should establish its own pension fund rather than enter into an arrangement with an assurance company. They have aimed at providing pensions for professors, readers and certain officers on the basis of compulsory retirement at a given age; the maximum pension to be £500 a year, or five sixths of the stipend, whichever is less, and to be inclusive of any college pension, stipend or emolument. They recommend that 70 should be the age at which retirement should be required, but they think that, if and when funds are available, this age should be lowered to 68 or even 65. Their main recommendations are: (1) That every professor, reader and university officer appointed to an office included in one of three schedules should be required to retire at the end of the academic year in which he attains the age of 70, and should receive a pension if he has served in the office of professor, reader or university officer for 15 years in all. (2) That professors and readers retiring at the age of 65 should become emeriti professors and readers without statutory duties and powers. (3) That professors with a stipend of £600 or more, the university librarian and the registrar should receive a maximum pension of £500 a year, and other professors, the readers and the other university officers a maximum pension equal to five sixths of their stipend. (4) That professors, the readers and the university officers should receive as a pension an annual payment equal to one twenty-fifth of the maximum pensions for each year of service. (5) That professors, readers and university officers under the age of 60 when the scheme comes into operation shall have the option within a year of joining the scheme.

THE *Geographical Journal* has received accounts of the progress of Dr. Zugmayer's expedition in Baluchistan. He went westward by Sumiami to Bela, and thence to Gondrani (where he examined the remarkable cave-dwellings), reaching Ormara on April 20. He found the people of this region extremely primitive in their mode of life. Gwadur was reached towards the end of May, and the second stage of the journey, the crossing of Baluchistan in a northeasterly direction, then began. Intense heat was experienced, temperatures of 127° F. in the shade and 158° in the sun being registered. Particularly trying were the hot sand-storms, during which travel is quite impossible, the human body losing more than a liter of water per hour by evaporation when they are at their height. In spite of all difficulties, Dr. Zugmayer was able to secure valuable collections of animals and plants, and also to make important zoogeographical observations in a region which is the meeting-point of the European, Inner Asiatic and Polynesian realms. Crocodiles were met with up to the Persian frontier, but land-snails and *Salmonidæ* were absent. Rats also were entirely wanting, though epidemics of plague are frequent. The traveler is inclined to connect the epidemics with the arrival from the north of vast flights of ducks, and he endeavored to obtain evidence as to the possible rôle of these as disseminators of plague, and also to find a reason for the visit of such birds in summer to such a burning region. On June 22 the caravan reached the small garrison of Turbat, and the worst of the heat was then left behind. Climbing a pass, the party reached the interior plateau of Baluchistan, attaining an altitude of over 3,000 feet, with a proportionately lower temperature, at Shakrok. The inhabitants of this interior region presented a marked contrast with those of the coast lands in their higher culture. The date-palm here supplies the staple article of diet, and its harvest is celebrated by festivals. Panjgur was reached on July 6, and was made a center for collecting trips and haunts. Dr. Zugmayer expected to be back at Karachi at the end of October, traveling by way of Kelat and Quetta.

UNIVERSITY AND EDUCATIONAL NEWS

THE will of Miss Emma Carola Woerishoffer leaves $750,000 to the trustees of Bryn Mawr College, of which she was a graduate.

THE estate of John S. Kennedy is even larger than has been previously announced. The share of Columbia University is $2,429,943. The New York Public Library receives $2,779,790; the Metropolitan Museum of Art, $2,929,943; the Presbyterian Hospital, $1,514,086; New York University and the Presbyterian Board of Aid for Colleges, each $976,647; Robert College, Constantinople, $1,847,295. The specific bequests, not dependent on the size of the estate, include $100,000 each to Yale, Amherst, Dartmouth, Bowdoin, Hamilton and Glasgow.

WILLIAMS has received a gift of $35,000 from the estate of Mrs. Frances E. Curtis for the endowment of the Edward Brust professorship of geology and mineralogy.

ABOUT $1,000,000 has been collected for establishing a residential Hindu University at Benares with an adequate European staff.

GROUND was broken last week for the Wolcott Gibbs Memorial Laboratory of Harvard University. This building, designed for research in physical and inorganic chemistry, will cost when completed about $72,000. It was given and endowed by Dr. Morris Loeb, Mr. James Loeb and many other friends of Dr. Gibbs and the university.

THE Association of American Universities met at the University of Chicago on October 26 and 27.

THE budget of Oberlin College for the ensuing year contains a special appropriation to be used in defraying the expenses of administrative officers, professors and associate professors who wish to attend meetings of educational and scientific societies.

NEW laboratories, completely equipped for post-graduate medical instruction and research, have been organized and opened at the

New York Post-Graduate Medical School and Hospital. The director is Jonathan Wright, M.D. (Columbia), and the staff includes—tropical medicine, in collaboration with the medical departments of the Army and Navy: James M. Phalen, M.D. (Illinois), captain Medical Corps, U. S. A., F. M. Shook, M.D. (Michigan), P. A. Surg., U. S. N.; bacteriology: Ward J. MacNeal, Ph.D., M.D. (Michigan), Richard M. Taylor, M.D. (Michigan); pathology: Ward J. MacNeal, Ph.D., M.D., Oliver S. Hillman, M.D. (McGill); biochemistry: Victor C. Myers, Ph.D. (Yale), M. S. Fine, Ph.D. (Yale).

Cornell University Medical College opened with an enrolment as follows: For the degree of M.D.: first year, 32; second year, 23; third year, 20; fourth year, 11. Special students (work not leading to the degree), 19. Doctors of medicine engaged in research, 9. A total of 114. There is a loss in numbers as compared with the preceding year which is due to the fact that all matriculants for the degree of M.D. now registered are admitted under the advanced requirements necessitating the presentation of a bachelor's degree in science or arts, together with something more than one year's work in physics, chemistry and biology. With the exception of those first-year students at Ithaca who are pursuing the combined seven-years' course leading to the degree of A.B. and M.D. all students now registered in this college are graduates in arts, science or medicine.

Dr. Harlan H. York (Hopkins '11), formerly instructor in botany at the University of Texas, has been made associate professor of botany at Brown University, in charge of the department.

At the Colorado School of Mines, George W. Schneider takes the position of professor of mining and Carl A. Allen that of assistant professor of mining. Both are practical mining men and former graduates of the school.

Mr. B. Tatarian, formerly instructor in the University of Illinois, has been appointed assistant professor of chemistry in the University of Arizona.

Carl L. Rahn, Ph.D. (Chicago), of the University of Pittsburgh, has been appointed instructor in psychology in the University of Minnesota.

At the University of Texas Dr. N. H. Brown succeeds Dr. A. C. Scott as head of the School of Electrical Engineering. Newly appointed instructors are: In physics, Dr. H. L. Brown, of California, succeeding Dr. C. L. Shuddemagen; in zoology, Dr. A. Richards, of Princeton; in electrical engineering, J. W. Ramsey, of Texas.

Dr. Karl Linsbauer, of Czernowitz, has been appointed professor of the anatomy and physiology of plants at the University of Gratz.

DISCUSSION AND CORRESPONDENCE

THE NEEDS OF METEOROLOGY

The session of the German Meteorological Society, held at Munich, October 2, included memoirs of general interest. Among these that by Professor Moeller, of Brunswick, appeals especially to Americans. His theme was the same as that which I have so often presented to American audiences, namely, "The Need of the Establishment of an Institute for Theoretical Meteorology."

For forty years I have indulged the hope that some intelligent American merchant would show his appreciation of the successful efforts of the practical meteorologists of our unrivalled Weather Bureau, and would establish a school of meteorology comparable with our great schools of astronomy, engineering, etc. But now I fear that Dr. Moeller's address may result in the founding of the German Institute that he wishes, long before our American establishment is under way.

The money value of meteorology began to be realized by American merchants when Maury studied the winds and currents and shortened the voyages of American clippers by 50 or 100 days. The money value of the modern Weather Bureau has been recognized during every storm and blizzard and frost and flood since January, 1871. The future of aerial

voyages, the hoped-for success of the aeroplane in war and in peace, the development of agriculture, the safety of our vessels, all depend on our knowledge of the atmosphere, and our anticipation of its vagaries.

We have done wonders on land and sea, on the mountains and underneath the oceans, but we have scarcely begun to appreciate what we may do in the atmosphere. We may not change its winds, its rains and snows, but we may learn to utilize them to advantage. The investment of a half million dollars in one laboratory, with its physicists and mathematicians devoted to research in the physics and mechanics of the atmosphere, would do for meteorology as much as the wonderful observatory at Mount Wilson is doing for astronomy.

One hundred years ago James Smithson of England entrusted his fortune to the United States as executor of his will, and from that evidence of his faith in America, innumerable benefits have followed. How long will it be before meteorology receives a corresponding attention?

The state of New York has furnished such men as Myer from Buffalo, Henry from Albany, Redfield from New York—eminent students who died without realizing their fondest hopes. Americans are profiting unconsciously by their labors in meteorology. Will they not invest 1 per cent. of their earnings in the promotion of an institute devoted to man's progress in this important science? They can do nothing better for humanity.

C. ABBE

MORE BOTANICAL ERRORS

PROFESSOR NEWCOMBE'S communication entitled "Professor Punnett's Error," on page 442 of the present volume of SCIENCE, prompts me to call attention to the fact that Punnett is not the only zoological writer who displays ignorance of elementary botanical facts. Two books in common use in our universities exhibit the same error as Mr. Punnett's book. One of these, "The First Principles of Heredity," by Dr. Herbert, contains the following exposition (page 21): "Among plants we find male and female germ-cells in all flowering species—the former, the pollen-grain, being developed in the anther of the stamen of the flower; the latter, the ovule, lying in the ovary, to which the pistil leads. Most flowers possess both sexual organs, stamen as well as pistil; . . ." It will be sufficient to point out three of the patent misconceptions in this extract: (1) the pollen-grain and ovule are not germ-cells; (2) the stigma or style, not the pistil, leads to the ovary, which is itself part of the pistil; (3) stamen and pistil are not sexual organs, for they bear *asexual* spores. The second work referred to is E. Davenport's "Principles of Breeding." On page 161, speaking of the ovum, the writer says "Its equivalent in plants is the ovule." In the next paragraph the writer says that the spermatozoon is "the functional equivalent of the pollen grain of plants." The errors here involve the same misconception as in the first case, but are less serious.

Botanists of course regret that the term ovary should have been wrongly applied to the sac which contains megasporangia, but the usage seems to be here to stay, and certain of our zoological brethren might well consult a dictionary when dealing with botanical topics.

M. A. CHRYSLER

"WASHINGTON SCIENCE"

UNDER the above caption which is assumed to have "depreciatory significance," "Washingtonian" "who has spent nearly half a century in scientific work, under government auspices" writes[1] defending government scientists.

It is with pleasure that I endorse every statement of his article and in many cases I could add much more of commendation from my personal knowledge. It is suggested that "outsiders" can help if they will to promote the ideal service, hence I have attempted to define what "depreciatory significance" the above title might have in my mind and to suggest a remedy.

It seems to me that the difficulty is one of

[1] SCIENCE, N. S., XXXIV., 405, September 29, 1911.

coordination, as far as the relation of industrial organizations to government science is concerned, arising from the fact that scientists in the government bureaus often have no adequate knowledge of the industries affected by the regulations which they are called upon to draw up and enforce and hence they are not in a position to properly distinguish between attempts to evade the law and real protests concerning unnecessarily restrictive rulings. Very few business concerns are engaged in anything comparable with the sugar trust frauds or would countenance anything of the kind, yet "Washington scientists" are apparently unduly influenced by such cases and do not appear to give sufficient thought to the thousands of concerns with whom they never have any trouble.

The remedy for this condition would appear to lie in the employment of a number of scientists in the executive work of the bureaus who have had adequate training in the industries affected, in place of the present plan of selecting all scientists for government work from men who have devoted their entire previous time to theoretical study and teaching.

In the ultimate analysis the industries of the country appear to be the financial foundation upon which our government rests, hence I would suggest that inhabitants of the structure occupying "top floor front rooms" should be a little more conservative in their treatment of this same foundation.

INDUSTRIAL ENGINEER

THE METHODS OF AMERICAN ETHNOLOGISTS

TO THE EDITOR OF SCIENCE: American students will welcome the views propounded by Dr. Rivers in his presidential address before the Anthropological Section of the British Association for the Advancement of Science (SCIENCE, September 29, 1911). Nevertheless, were Dr. Rivers telescopically gifted, he would assuredly read nothing but amazement and surprise in the expression of American ethnologists' eyes as they peruse his extraordinary characterization of their activity as compared with that of their colleagues in other lands.

Dr. Rivers's paper is essentially a declaration of independence from the traditional point of view of his compatriots, who, to use his own words, have been "inspired primarily by the idea of evolution founded on a psychology common to mankind as a whole." His own investigations in Melanesia have converted Dr. Rivers to the teachings of the geographical or "ethnological" school, whose home, past and present, he finds in Germany. He has arrived at the conclusion that a direct psychological interpretation of cultural phenomena is impossible, because it ignores the demonstrable blending of different cultures. Psychological analysis, he contends, must be preceded by an ethnological analysis: ". . . if cultures are complex, their analysis is a preliminary step which is necessary if speculations concerning the evolution of human society, its beliefs and practises, are to rest on a firm foundation" (p. 391).

Apparently, Dr. Rivers has never met with any thing like such views in the writings of American ethnologists, for among these he recognizes only either purely descriptive recorders of data concerning the Indians, or writers who, like Kroeber in his "Classificatory Systems of Relationship" and like Goldenweiser in his "Totemism: an Analytical Study," investigate social problems from a purely psychological point of view.

Now, as early as 1895, Dr. Boas was led by his study of mythology to an expression of opinion so closely resembling the recent utterances of Dr. Rivers that it is almost inconceivable how the resemblance could fail to be noticed. At the conclusion of his "Indianische Sagen von der nord-pacifischen Küste Amerikas" (p. 353), Boas emphatically protests against a direct interpretation of myths as expressions of universal ideas before investigating the historical and geographical causes conditioning the growth of mythological tales. A still more comprehensive statement appears in the same writer's "Introduction" to the "Publications of the Jesup North Pacific Expedition" (Vol. I., 1898–

1900): "We are still searching for the laws that govern the growth of human culture, of human thought; but we recognize the fact that before we seek for what is common in all culture, we must analyze each culture by careful and exact methods, as the geologist analyzes the succession and order of deposits, as the biologist examines the forms of living matter."

It is not too much to say that during at least the last decade Professor Boas's point of view has dominated the ethnological work of the younger ethnologists of this country. American ethnologists have been well aware of the opposition of their methods to those of the traditional evolutionary school, as might be gathered from Wissler and Lowie's annual survey of anthropological activity in *The New International Year Book* (for 1907 and 1910) or the present writer's comments on Schurtz's and Webster's theories as to the development of secret societies ("The Assiniboine," p. 75). Nor has this *American* point of view been without influence on detailed ethnographic study. In the investigation of the Plateau area, the doctrine of a blending of cultures has been the theoretical peg on which we have hung our facts. This view is dominant, for example, in Dr. H. J. Spinden's monograph on the Nez Percé. It is certainly still more remarkable that this geographical attitude common to many American students should have escaped Dr. Rivers's attention even in one of the two American papers specifically referred to by him. For Goldenweiser's investigation of totemism is not only permeated by the spirit of the historico-analytical method, but includes, in the final chapter, an emphatic protest against any other method of inquiry for the reconstruction of cultural development.

Nevertheless, questions of priority or misunderstanding are relatively unimportant. The significant fact remains that one of the most distinguished of English ethnologists now finds himself in substantial agreement with the position generally held in America.

ROBERT H. LOWIE
AMERICAN MUSEUM OF NATURAL HISTORY

QUOTATIONS

REFORM IN COLLEGE ENTRANCE REQUIREMENTS

THREE notable reports, dealing with requirements for admission and the relation of these to the high-school curriculum, were made at the last meeting of the New England Association of Colleges and Preparatory Schools at its recent meeting held at Cambridge, October 13 and 14.

President Lowell's report on the operation of Harvard's new alternative method was of especial interest inasmuch as it gave the first results of the test of the new plan. This plan aims to get into closer touch with the high schools, especially those in the west, rather than the private fitting schools, by giving the secondary school greater freedom in courses and methods of study. President Lowell reported that there were 206 applications for admission under the new plan. Of these 66 were refused admission upon their school record. Of the 140 allowed to try, 57 were rejected, 83 admitted. In other words, a larger number of candidates was refused admission under the new plan than under the old. Moreover, several students rejected under the new plan in June were admitted under the old regulations in September.

As to the geographical distribution of candidates: under the old plan 84 9/10 per cent. came from New England states, 8½ per cent. from the other Atlantic states and but 4½ per cent. from the western states. Under the new plan, 47 per cent. of the candidates came from the New England states, 41½ per cent. from the Atlantic states and 21½ per cent. from west of the Alleghenies. As to the character of preparatory school: Under the old plan, 54 per cent. of Harvard's students came from private fitting schools, 45 per cent. from public high schools. Under the new plan there were 15½ per cent. of the candidates from private schools and 83½ per cent. from public schools.

In sharp contrast with the requirements and methods of Harvard and the other eastern examining colleges is the new method of admission to the University of Chicago as reported at the same meeting by Professor Judd and the plan proposed by the National Educa-

tional Association. These two reports indicate the increasing differences between the eastern and western college. Some of the differences are, of course, evident. Practically all students of western colleges are prepared in public schools and are admitted on certificate, whereas the New England "examining" colleges depend very largely upon special fitting schools. But the more radical and far-reaching distinction between colleges of the east and the west arises from the fact that the more conservative of eastern colleges still prescribe a large proportion of the subjects and methods of the preparatory school. The western college, on the other hand, has in large measure accepted the dictates of the high school and has practically surrendered the right of intervention in the courses of preparatory study.

This position of the western university is well shown and ably defended in the reports just referred to. They urge that the requirements for admission should be entirely divorced from *subjects* and that the college should confine itself to stating the number of units required. In other words, the college should content itself with stating the *process* and *time* requisite for preparation rather than the *content*.

In view of the prevalence and strength of this "insurgent" movement in the western institutions there can be little question that these plans and methods will be urged upon the eastern colleges. To the conservative, the measures adopted and advocated seem absurdly radical and subversive of sound education, but he recalls that the high school curricula, except in very restricted areas of influence, go their own way with little or no consideration of college requirements, and that in the long run the high-school man has usually dictated the requirements for college. A preparation for college, however, which did not include foreign language or mathematics (except arithmetic) and with more than half of the school course represented by commercial and vocational studies would seem to him to be a misnomer. There can be little doubt that such extremes bear the seeds of reaction; but this does not relieve the eastern college from the responsibility of making its entrance requirements such as not to bar it from intimate connection with the public-school system of both the east and the west.—Professor Robert N. Corwin in the *Yale Alumni News*.

SCIENTIFIC BOOKS

An Investigation of the Rotation Period of the Sun by Spectroscopic Methods. By Walter S. Adams, assisted by Jennie B. Lasby. Carnegie Institution, Washington. 1911.

This publication gives a complete account of the investigations undertaken at the Solar Observatory of the Carnegie Institution, Mount Wilson, Cal., upon the Rotation of the Sun in the years 1906–07 and 1908, embodying results previously published in the *Astrophysical Journal* and in the "Contributions from the Mount Wilson Solar Observatory." These, however, contained only brief summaries of the principal portions of the work which is treated in detail in an admirably comprehensive and yet concise and logical manner in the publication under review. The arrangement of the material in this work and the plan of treatment of the numerous observations recorded is one that might with advantage be copied in reports of scientific investigations which are too frequently lacking in the logical treatment necessary for the proper exposition of the results obtained.

After a succinct and yet complete account of the work previously done on the spectroscopic determination of the solar rotation, the instrumental equipment used in the two series of determinations is described. The first series in 1906–07 was made by means of the "Snow" cœlostat telescope and an 18 foot focus, Littrow form, grating spectrograph. The second series, which, as the author claims and the observations show, is superior in accuracy to the first, was made in 1908 with the 60-foot Tower telescope and a 30-foot focus grating spectrograph also of the Littrow form. The linear dispersion for the first series at λ 4250, the center of the region employed, was 1 mm. = 0.71 Å., and for the second 1 mm. = 0.56 Å., comparatively high dis-

persions, the latter giving a maximum displacement, at the solar equator, of about 0.090 mm.

Considerable space is devoted to a discussion of the possible sources of error and it is evident that the greatest possible care was taken to avoid all known causes of systematic displacements of the lines and consequent error in the velocity. In most astronomical work systematic errors are much more to be feared than accidental errors and this is especially true in this case where the line displacements to be measured are small. The greater relative importance of what might be called plate errors over the accidental errors of measurement is clearly shown by the results obtained in this investigation, where the probable error of the mean value of 21 plates is considerably less than the probable error of a *single* plate as determined from the internal agreement of the 22 lines on the plate —a ratio of plate errors to measurement errors of more than five to one. The method of measurement and reduction is concisely and yet fully described and is followed by the detailed measures of the plates obtained in the two main and two supplementary series which are then conveniently summarized.

The discussion of these results is admirably arranged so as to present in a convenient form the conclusions reached, the most interesting and important of which may be briefly stated.

1. So far as the period covered by these observations goes, the sun's rate of rotation is constant, the slight difference found in the two series being ascribed to the slightly less satisfactory instrumental conditions in the first series.

2. The retardation of the rate in higher latitudes is satisfactorily represented by an equation of the Faye type taking the form for these observations of

$$\xi = 11°.04 + 3°.50 \cos^2 \phi$$

where ξ is the daily angular sidereal velocity and ϕ is the solar latitude.

3. The lines of different elements in the reversing layer give different values of the rotational velocity, which, though small, are believed to be real, those known to lie at low levels giving low values, and *vice versa.* This is especially the case with $H\alpha$ and Ca λ 4227, which move at a more rapid rate than the general reversing layer and in which the retardation towards the higher latitudes is very much less.

4. The comparison of $H\alpha$, λ 4227 and lines in the reversing layer shows that the velocity increases and the polar retardation decreases with increasing distance outward, the cause being assigned as probably due to the effects of friction in the lower portion of the solar atmosphere.

The whole work sets an exceedingly high standard of accuracy, which it will be difficult for other observers to equal. Taking for example some of the probable errors of measurement obtained, we have in the second series the probable error of measurement of the displacement of a single line ± 0.009 km. per sec., equivalent to a linear error of only about 0.0004 mm., less than half a micron. Those who have had experience in measuring spectrum lines where a probable error of a micron is considered good measuring will recognize the remarkable accuracy obtained, several times greater than previously secured in the same problem. The corresponding error of a plate is ± 0.002 km., the thousandth part of the equatorial velocity. Notwithstanding what was previously said concerning systematic displacements the agreement among different plates is also remarkably good, the probable error of a single determination of the rotational velocity being not much greater than ± 0.01 km., giving the probable error of the mean value of the velocity in the neighborhood of ± 0.003 km.

Professor Adams and Miss Lasby are to be congratulated upon the very high accuracy of this determination of the solar rotation, upon the interesting and important conclusions derived from their measures, and upon the manner of presenting the formidable amount of material on hand. Furthermore, they, with the Carnegie Institution, are to be

congratulated on the mechanical excellence of the completed volume.

J. S. Plaskett

Dominion Observatory, Ottawa,
October, 1911

Photography for Bird-Lovers: a Practical Guide. By Bentley Beetham, F.Z.S. With Photographic Plates. London. 1911. Pp. i–vi + 122.

This handy little volume is designed to serve as a manual and guide in bird-photography in its widest sense, and while addressed to beginners in the art, and to lovers of birds and of sport rather than to ornithologists and trained naturalists, all interested in birds will find in it much to attract them. More particularly, the expressed object of the author is to show how pictures of birds, whether dead or alive, captive or free, can be best obtained, rather than to direct the steps of his reader into the paths of the naturalist, to show him how to study, and to use his camera as a tool for recording and supporting his observations.

In every such work we should like to see it clearly stated that the higher object of bird-photography is not simply to "embody a little story," or even "to portray the living bird in some characteristic pose or action," though this be all very well, but rather to obtain a pictorial analysis of behavior, as registered in all the more characteristic movements and attitudes, made or assumed by birds. This, 'tis true, is a subject which requires ample leisure as well as training and skill, but one, it would seem, in which many young students, who, happily possessing the former, might be led to acquire the latter, and thus to extend the boundaries of knowledge. We think that the attitude of any author could be raised to this plane without loss in interest, and with decided gain in value.

Some of Mr. Beetham's specimen illustrations, and particularly the habitat pictures, which show the nest or bird with its surroundings, could hardly be improved, such as the oyster catcher's eggs on page 28, or the grouse on page 56, obtained by setting the camera very low down. I think, however, that the value to students of all really excellent photographs of this character would be enhanced by adding, either on the page or at the end of the book, the essential photographic data, a thing usually neglected.

If one were disposed to be critical, though we hope, not hypercritical, he could find more exercise of this power in the longest and most important chapter in the book, that on the use of the concealing tent. The present reviewer, so far as he knows, was the first to use a *bona fide* unadorned tent for the close at hand study of birds, in the summer of 1899, so that perhaps he is a little over keen on the subject. In a work on the "Home Life of Wild Birds," published in 1901 and again in 1905, the bird-tent was fully described and illustrated, with an exposition of the psychological principles governing its use. Many were inclined to look askance upon our tent and methods in 1901, but no attempt seems ever to have been made to dispute the principles at stake. All this, however, is a matter of history, and we are now interested to see that our tent has become a fixture for the intimate study of nest-life, and further that at the end of this very volume a "hiding tent" is advertised for sale by a London dealer. To continue, the present writer's tents, plain and unadorned, have been in use—one of them at least—for twelve years, and with them he has worked at the close range of 70 nests, pertaining to from 30 to 40 species of wild birds, often spending a week at a given one. Further, since accidents from every cause, including the weather and living enemies, have hardly exceeded one in ten, and can be reduced to almost nothing by a proper use of the wire screen whether the original position of a nest is changed or not—he should be qualified to speak on the score of experience at least.

The use of the concealing tent is indeed based upon certain fundamental principles, the force of which experiments in the field, year after year, have only tended to confirm. While any detailed discussion of them would be quite out of place here, we might intimate that the most important are the gradual rise of the "parental instincts," and consequent depression of fear, most marked from the beginning of incubation, the force of habit, and

the freedom with which new habits are formed. All procedure is to be directed upon this basis, with variations, if need be, to suit the species or the individual and the state of its instincts at the time. We know, for instance, when to successfully approach with the tent the cuckoo or the cedar waxwing, when, the herring gull or the tern, for experiment has shown how they may be expected to behave under certain conditions. We have never found "concealing the tent," to which Mr. Beetham devotes a section, necessary, when the element of time was no object, two hours being usually enough to indicate the character of approach permissible. Nor have we ever needed "dummy cameras," nor had to consider "a comfortable position," when using the tent. So far as comfort is concerned, we cut the Gordian knot long ago, and should never think of using anything but a commodious tent, in which any one can stand, sit, write or read at ease, and be as comfortable as the temperature will permit.

If birds are to become accustomed to the tent itself, any question as to its size, form, or even color is of little consequence to them. The occasional nesting of many kinds of birds in incongruous, noisy, or even dangerous situations surely ought to have made this fact clear. A wall-tent of convenient size, such as we have always used, supported by a compact folding frame, guyed and pinned below, is certainly the best model for general use.

With many species indeed, an abrupt approach with a plain, unadorned tent is permissible, whether the original position of the nest be changed or not, while in other cases a more gradual access, with the use of a certain degree of finesse, is as clearly demanded for complete and assured success. In any case our procedure will depend very largely upon the strength of the parental instincts, or the condition of eggs or young. The depression of fear and consequent rise of the brooding and other instincts is expressed by fairly definite curves in a given species, and in entire ignorance of such conditions it would be hazardous to pitch any sort of a tent within a few feet of any nest, particularly when there were eggs, and fresh ones at that. On the other hand most birds with advanced young can be easily approached with the tent, without effort to conceal it, whatever the nest's position. In such cases the point is, not to cover the tent with leaves and other "familiar objects," but to make it a familiar object itself, a part of the landscape, as it were; in many cases the birds come to alight on it as they would upon rock or tree. Instinct may excite fear in the unfamiliar, but then habit commonly steps in to allay it, and that often in a surprisingly short time.

Mr. Beetham's experience with the lapwing is instructive, and one which has been repeated many times when we have been working with gulls, cedar waxwings and other wild species. In this instance the fear of a timid bird is gradually allayed by habit, until it becomes indifferent to sounds of whatever violence, and although close to the fixed eye of the camera, it is not readily driven off unless by some decisive movement, as by striking the wall of the tent or waving a hand outside. In all such cases, however, the obvious corollary does not seem to have been drawn, namely, use a tent of convenient size, and trust to habit to "conceal" it.

The author's chapters on work upon cliffs by the aid of ropes, and upon the rapid photography of birds in flight are excellent, but we should have liked more explicit information on the subject of cinematography, or the making of "moving pictures" of birds, since this is a subject about which very few naturalists are informed, in this country at least; ordinarily one might as well consult a graven image for the desired information as any oracle of a trust-controlled business. My own experience in the field has shown that moving pictures to record the activities of life at the nest are readily made, provided the birds have been subjected to the proper training, after methods which we worked out many years ago, when no muffling of the machine, or dummy "musical box," such as the author describes, is commonly necessary: nor should we ever think of covering the protruding legs

of the tripod with vegetation, for, if the reader will transpose,

> "A primrose by the river's brim
> A yellow primrose was to him,
> And it was nothing more."

Francis H. Herrick

Travels in the Confederation (1783–1784). From the German of Johann David Schoepf. Translated and edited by Alfred J. Morrison. Philadelphia, William J. Campbell. 1911. 2 vols. $6.00.

Few, if any, of the early travelers through America showed a wider mental grasp on matters falling under their observation than did Dr. Johann David Schoepf, a surgeon to the Bavarian troops employed by the British government in their vain attempts at subduing the unruly Americans during the war of the Revolution, and who subsequent to the declaration of peace made, for that period, extensive journeys through the eastern and southeastern United States. Schoepf was no mere specialist. His training had been broad and he lived at a time when it was possible for one mind to grasp and perhaps master the essentials in all branches of science. That he was a man of more than ordinary powers of observation and scientific acumen is evident from his published writings, which cover a wide range in ethnology, meteorology, biology, botany and geology. He was, according to Goode, the author of the first special ichthyological paper ever written in America or concerning American species, while his "Beyträge zur mineralogischen Kenntniss des ostlichen Theils von Nord Amerika" (1787) was the best systematic record of the geology of the eastern United States that had appeared up to date. The breadth of the man, however, is nowhere shown to better advantage than in the work now under review. "I willingly admit," he wrote, "that these notes are neither so complete nor of such importance as I could wish, but . . . to be candid, the motive of my journey was curiosity."

Whatever the motive, it is difficult to conceive of his getting into readable form and in a limited space a greater amount of information on a variety of subjects than here, and a hearty vote of thanks is due Dr. Morrison for thus bringing to life, resurrecting, as one may say, a story of travel which might otherwise remain inaccessible to most readers and hence be forgotten.

After seven years of garrison duty Schoepf began his *Reise* in July, 1783, by boarding a flat-bottomed water craft known as a "petty augur" bound for Elizabethtown, New Jersey; thence by various modes of conveyance he proceeded through the state into Pennsylvania as far west as Pittsburgh and southward into Maryland, across the Potomac into Virginia, the Carolinas and from Charleston by boat to Florida, returning by way of the Bermudas to Europe. His narrative is in form of an itinerary and is really extraordinary in its detail. No object or item was too small for his consideration, or apparently too large for his comprehension. He noted the general physical features of the country passed over, its climate, mineral productions, soil, vegetation, animal life and the cities and towns and their manner of government. The character of the people and their personal idiosyncrasies are discussed in a way comparable only with the later writings of Featherstonhaugh in his "Journey through the Slave States" (1839), though from a less cynical standpoint. He seemed not favorably impressed by the German farmers of Pennsylvania. "They give their children no education." "Their conversation is neither interesting nor pleasing." With the people of Virginia he is likewise disposed to be critical, but considers their objectionable characteristics as in part due to the debasing influence of slavery. The Assembly he did not find impressive. "Among the orators here is a certain Mr. Henry." (Presumably Patrick—he of "Give me liberty or give me death" fame.) "He has a high-flown and bold delivery, deals more in words than reasons, etc." Charleston, South Carolina, in spite of a climate which he states makes it in spring a paradise, in summer a hell, and in autumn a hospital, is described as one of the finest of American cities, and, Philadelphia excepted, inferior to none.

The geology given is naturally largely of a mineralogical nature, though the possible effects of uplift and erosion were partially comprehended. The following description of the marble beds of Swedes Ford, Pennsylvania, is characteristic:

These strata, resting one upon another almost perpendicularly, are very clearly distinguished by divers rifts and clefts as well as by changed colors. This can scarcely have been their original bearing; rather it is likely they have suffered a powerful alteration in their bed.

Copious notes are given on the mineral resources, together with descriptions of mines and remarks on the condition of the metallurgical industry and the effects of tariff legislation. The need of a "trust buster" was evidently manifest even at that early date. Concerning an unsuccessful attempt to check imports by high duty on the part of the iron workers of New Jersey and Pennsylvania we are informed:

Therefore several of the larger furnace and forge masters proposed to hinder the further import of foreign iron by coming to an agreement among themselves that whenever iron came in from Europe they would offer their own at a certain loss under the prices of the European merchants so as to frighten them off from further imports.

The volumes are of convenient size, good paper and type, and the rendering into English well done. It is a work which those interested in the beginning of science, or the early history of the country may peruse with pleasure and which all may read with profit. One can but hope that it will meet such a reception as may lead to a like rendering by Dr. Morrison of the "Beytrage" above mentioned.

George P. Merrill

THE INTERCOLLEGIATE GEOLOGICAL EXCURSION

The eleventh Intercollegiate Geological Excursion, though it began on "Friday the 13th," was blessed with perfect weather and the attendance was over 70. We regretted the absence of Professor William Morris Davis (to whom a greeting was sent) and Secretary Professor Cleland (detained at the last moment) yet the presence of Dr. C. A. Davis, the peat expert of the Bureau of Mines, and David White, from Washington, and a delegation headed by Professor Chadwick from St. Lawrence University, helped to make up. The state geologists of Connecticut, Rhode Island and Vermont (there is none in Massachusetts) were present and members of the faculties of Dartmouth, Vermont, Amherst, Smith, Mt. Holyoke, Yale, Worcester, Boston and Salem Normals, as well as the immediately adjacent institutions of Harvard, Tech. and Wellesley. Professor Lane, of Tufts, had charge of the excursion.

Starting Friday noon from Davis Square, Somerville, at Morrison Avenue a diabase dike ridge of La Forge's "Older" E.W. family was visited, then at the corner of Francesca Avenue was a temporary exposure showing the Somerville slates beautifully glaciated and the preglacial weathering not entirely removed, a north striking camptonite dike with brotocrystals of biotite and an older labradorite porphyrite. Then near the old powderhouse the diabase with quartzite inclusions was shown on the terraces and its peculiar spheroidal weathering. This was visited again at Governor's Avenue in Medford and unpublished analyses by C. N. Whitney, showing that the weathering is largely oxidation and hydration without leaching, were shown that evening by Professor Lane, who called attention to the fact that the phosphorus seemed higher in the weathered material and thought that the weathering was in some ways like that of an arid region. He also said that his studies[1] showed that if the consolidation temperature was something like 1100° C., the initial temperature was near 2000°. Thence passing along Broadway, hills and drumlins were being cut away, showing rock core, with accumulation of the till on the lee side exhibiting also some sign of nipping by an old ocean shore 35 feet above the present level.

On Simpson Avenue (Nos. 69 and 31) in temporary excavations for cellars, sections of washed gravel were exposed—largely an

[1] "Die Korngrösse der Auvergnosen."

overwash gravel plain from the ice but a boulder of the weathered diabase and an unconformity were seen—the upper layer being more oxidized and leached, the lower showing more cross-bedding with a considerable amount of hornblende with the quartz, suggesting a beach deposit lying on top of the gravel plain. At No. 69 the underlying slate, *not* smooth and glaciated, was shown.

At the Holland St. quarry Professor Palache showed veins (confined almost to the diabase) in which calcite, quartz, siderite and almost microscopic anatase and other minerals have been found.

Passing over College Hill other sections of till above the 35-foot line and of shearing and jointing in the slate, which on Quincy Street dips nearly vertically and has numerous small faults, were shown. The extensive view from the reservoir shows the peneplain of the Middlesex Fells, the lower land of the Boston Basin, the glacial outwash gravel plain of Arlington, a quarry on the Fellsway in felsite with calcite and specular hematite and barite in veins (later visited), the drowned valley of the Mystic with its salt peat marshes and numerous drumlins. Descending to this valley Dr. Davis pointed out the freshening of the *Spartina patens* salt marsh indicated by the invasion of various fresh water plants. This has all happened in three or four years while the dredge has thrown up signs of fresh water peat at a considerably lower level than the sea level.

Next were visited the Medford diabase weathering on Governor's Avenue and Fellsway quarry and the Wellington clay beds. Here were found two distinct beds of clay with a sand layer between, and above a bed of gravel which Gulliver showed by the per cent. of angular pebbles was undoubtedly glacial outwash. Barton called attention to faulting in the sand and cementing of the sand into sandstone and conglomerate. The Mystic valley is, then, largely filled by this gravel plain and on top of it is the marsh deposit of irregular thickness, sometimes not very deep. In other hollows of the gravel plain we find (*a*) fresh water peat, with sticks and leaves, 10 feet; (*b*) fresh water swamp bed with stumps; (*c*) brackish water swamp, 1 ft.; (*d*) thin high tide *Spartina patens* salt water deposit. Stumps of a former pine forest were very conspicuous near the margin and were connected with a fresh water peat layer pointed out by Professor Davis, on which grew a salt marsh. The evidence that this pine forest had been invaded by the salt marsh was not challenged by any one and the freshness of the pine stumps showed that it was relatively recent, as D. White emphasized.

Professor D. W. Johnson, however, pointed out in the discussion which took place that evening in the Barnum Museum at Tufts College that certainly at Scituate and in some other cases such invasion of salt marsh was due to an increase in tidal range without any subsidence of the land, and that if the tidal range outside a barrier beach was, say 20 feet, in going up a stream that range would gradually diminish, so that if a beach were broken through, or driven back, *or in any way the access of water made more free, the increase in tidal range would take place and produce an effect of apparent subsidence, while mean sea level might not differ.*

The same evening Professor Fernald, of Harvard, gave an interesting account of the flora of Newfoundland,[2] which while it has Labrador and Polar plants, has very few of the Canada flora only seventy miles away across the Gulf of St. Lawrence but has a large percentage of plants of the sandy southern coastal plain from Cape Cod south. There is a bar between Newfoundland and Cape Cod which might have been uncovered when the water of the ice sheet was taken from the ocean.

Professor Johnson gave the account of the development of Nantasket which had already been visited in an earlier excursion[3] and pointed out with very strong argument that the level had remained fixed within a couple of feet for over a thousand years—probably several thousand—derived therefrom. He also

[2] Described in the July *Rhodora*.

[3] SCIENCE, 1906, p. 155.

reviewed some of his recent observations along the Atlantic and European coasts. He emphasized the point not often brought out that most of our evidence of subsidence is referred to high tide, and that a change in the range of tide may show apparent subsidence.

Professor Davis was not able to agree with Johnson. He had found sections of as much as twelve feet of salt water peat formed mainly of *Spartina patens* which only occurs a few inches below high tide and is replaced by fresh and brackish water forms with a very slight elevation, and if the exposure to salt water amounts to more than a couple of hours a day is replaced by another species—*Spartina glabra*. The occurrence of such deposits composed almost exclusively of *Spartina patens* from top to bottom seemed to him to prove almost conclusively a steady subsidence and he presented a bit of evidence for the first time as to the rate thereof. The upper layers of marshes at Neponset and Revere crossed by the railroad show for the upper three inches more or less of the peat particles of cinder from the locomotive so that there appears to have been accumulation of something like three inches in the last fifty years or so.

On Saturday the ferry across Boston Harbor gave an opportunity to see the general physiographic location of the Navy Yard bench mark which according to Freeman shows subsidence. This is explained by Johnson as presumably due to a higher range of tide owing to the filling of the Back Bay, etc., which once led off the waters. The question as to the effect of wharves and embankments on the high tide was discussed.

The train gave very good views of sections of drumlins and at Revere Beach, the site of Cherry Island (now entirely washed away) was noted, and the peculiar scallops on the shore. These are explained by Johnson and Lane as due to the waves taking advantage of irregularities and in breaking making sidewise fountains, as they may be called, which extending laterally have a limit of breadth depending on the height and size of the waves. On the back side of Revere Beach the once forested swamp showed stumps and on top a salt marsh turf. New ditches showed the section of the turf and the creeks which drained the marsh showed how sensitive to level the flora was, because in any small depression there was the *Spartina glabra* while on the knolls around the stumps was a more complicated flora with goldenrod and asters creeping in. The salt water peat had a strong odor of sulphureted hydrogen and the darker peat at the bottom showed brackish water formations.

Around Oak Island (a large group of trees slightly above tide level) no rim of stumps was seen as would be expected, except a few poorly preserved stumps of oak and hickory. The salt peat was shown to contain only the roots and underground parts of the plant, not the leaves and aerial parts as the fresh water marshes because they were swept bare by the tide. Beneath this part of the marsh was about 9 feet of salt water peat in general and in order to explain it as not due to continuous subsidence Professor Johnson had to explain it as due to subsidence of several feet several thousand years ago followed by an apparent subsidence of a foot or two more recently due to the changes of the run of tide. The objection to this was that no marked break was found as might be expected.

In a partly cut away drumlin Professor Perkins recognized some boulders, similar to the Vermont red sandstone, which may be of Cambrian age.

On the way from Revere Beach to Nahant a brief stop enabled one to see the ripple marks and rills and other phenomena of the Lynn Beach.

At Nahant was visited another salt marsh which is fourteen feet deep with two feet of sedge and twelve of salt marsh peat. On the golf links relics of stumps were again visible. The beach connecting Bass Point showed the high water scallops once more and Professor Johnson gave an account of their formation and some experiments he had made in producing artificial scallops.[4] At low tide this beach is said to show peat passing under it and Professor Johnson explained such peat

[4] See *Geol. Soc. Am. Bulletin*, Vol. 21, pp. 599–624.

found out under the waves, by consolidation and depression as the barrier beach worked over them, describing a place where wagon tracks occurred. Of course, Professor Johnson does not deny that there has been subsidence and peat formed at lower levels, but probably several thousand years ago.

After dinner Professor Lane took charge of one party (while others studied the peat) and showed typical gabbro and various diabase dikes. He called attention to the basaltic columnar structure of some of these dikes and also a jointing which enabled one to obtain the dip of the main gabbro mass itself. Bass Beach and Canoe Beach both offered excellent opportunity to see the beach scallops in formation. Passing on to Pulpit Rock the finer grain of the gabbro near the contact was noticed and its contact with siliceous and argillaceous limestones changed to epidote and garnet rocks and black basanite. Some of the party found Hyolithes while others passing back along the north shore of the island had a good chance to observe the differentiation of the gabbro into a salic or syenitic phase (which Professor Lane called a gabbro aplite) and a dark peridotic phase near Black Mine. There were numerous other points of interest which attracted some of the crowd (which gradually dispersed) such as faults and the comparison of the rounding of the pebbles with those of the overwash gravel plain.

E. H. & A. C. L.

SPECIAL ARTICLES

A NEW MINNOW FROM COLORADO

A SMALL fish collected by Mr. Horace G. Smith at Julesburg, Colo., has been the occasion of much correspondence and discussion, but may now be brought forward as apparently undescribed.

Notropis horatii n. sp.

Type. Length 58 mm., to base of caudal 47; depth 9 mm., width 5½; D. 8, A. 9; scales 5 or 6—38 to 40—4; dorsal region clear ferruginous, with a fine dusky band; a rather broad lateral silvery band; scales of lateral line with little dark spots, as in *N. telescopus;* fins yellowish-white, no spot on dorsal or caudal; front of dorsal to base of caudal 24 mm., to end of snout 23; dorsal fin beginning a little *anterior* to level of pelvic; region before dorsal not bare of scales. Scales with 9 apical radii.

This was supposed to be *N. piptolepis* (Cope) or *N. gilberti* Jordan & Meek, these two names being considered by Drs. Evermann and Kendall probably synonymous. At the U. S. National Museum I found the type of *N. gilberti,* which proves to be very distinct, as follows:

1. *N. gilberti,* type. Diameter of eye 3.9 mm., snout beyond eye 3; depth of head 7.35 mm.; snout to base of caudal 39; beginning of dorsal level with beginning of ventral; no dark dorsal band; ventral scales exceedingly broad.

2. *N. horatii,* type. Diameter of eye 3, snout beyond eye 3.4; depth of head 6.35 mm.; snout to base of caudal 45.5; beginning of dorsal in front of beginning of ventral; a dark dorsal band; ventral scales ordinary.

Both have a silvery lateral band; the dorsal area of *gilberti* is darker and redder. The dorsal profile of head and anterior part of body in *horatii* is practically flat. The corners of the mouth in *horatii* are a little anterior to the level of front of eye.

The question now arises whether the fish can be *N. piptolepis,* to which it runs in my table of Colorado Cyprinidæ (Univ. of Colo. Studies, Vol. V., No. 3). The type of *piptolepis* seems to be lost, as it was not found at the National Museum, and Fowler does not list it in his account of the species in the collection at Philadelphia. Possibly the name may have to be given up as undeterminable, but we have a mason-jar full of a species collected in Boulder Creek by Juday, recorded by him as *piptolepis* and accepted as such by me. This fish is certainly quite distinct from *horatii,* and I believe it to be Cope's species. Although *N. horatii* is doubtless of the immediate alliance of *piptolepis* and *gilberti,* it is superficially very like *N. stilbius* and *N. telescopus,* in another group. The species is

named after Mr. Horace G. Smith, of Denver, who has long studied the fauna of Colorado, and who went to great trouble to revisit the locality and obtain additional material. The other Cyprinids found by Mr. Smith at Julesburg were *Semotilus atromaculatus macrocephalus* (Girard) and *Phenacobius scopifer* (Cope).

T. D. A. COCKERELL
UNIVERSITY OF COLORADO

A BACTERIAL GUMMOSIS OF CHERRIES

CERTAIN varieties of the cultivated sweet cherries grown in the Pacific northwest are very subject to a diseased condition which is commonly known as "cherry gummosis." The disease is characterized by more or less copious exudation of gum from the trunk, branches, spurs and buds as well as by a pustulated appearance of the bark near the diseased areas. Often but little gum is exuded, but in such cases an examination of the affected trees generally discloses discolored tissues which is infiltrated with gum. Such areas are spongy to the touch and are usually discernible by the variation in color of the bark as compared with that of the normal.

Gummosis is found in every cherry growing section of Oregon, but it is in the more humid portion of western Oregon that its prevalence and destructiveness gives it the rank of a major disease, and where its appearance in an orchard is most dreaded by the grower.

Cherry gummosis appeared soon after the first planting of cherries in the state. Its prevalence has varied from season to season, being apparently more abundant in those years when the trees experienced rather sudden extreme variations in temperature after growth had started. This has led observing growers to attribute the trouble chiefly to the climatic factor. The disease appears on a wide range of soil, but the trees growing in the more exposed locations or on poorly drained or shallow soil are generally the worst affected.

Cherry gummosis appears in both a localized and generalized form. In the former, the disease is apparently confined to rather limited areas on the trunk or branches, such areas being most often associated with a blighted spur or bud. In the generalized form, large areas of the trunk or branch may become involved, and it often results in complete girdling. This latter type of gummosis often appears to originate in the crotch of the tree.

The writer was assigned the problem of investigating the possible causes and prevention of cherry gummosis while a student in the Oregon Agricultural College. In the spring of 1909, I noted bacteria in sections of blighted cherry fruit spurs, and upon making cultures from fresh material, found the organisms to be rather constantly associated with such diseased spurs. I had to drop the investigation for the time being on account of the stress of other work, but from the few direct inoculations made into healthy spurs a blighting or gumming occurred.

In the spring of 1910 a large number of cultures were made from material procured in different cherry-growing sections. In the agar plates resulting from such cultures, one type of organism seemed to predominate, and it often appeared in pure culture. From pure cultures thus obtained a series of inoculation experiments were made in which the organisms were transferred from agar slants to healthy fruit spurs by needle pricks. The spurs thus inoculated, blighted or gummed, while the checks healed without blighting or gumming. The typical organism was re-isolated from the inoculated spurs and again inoculated into other healthy fruit spurs. These inoculated spurs again blighted and gummed while the checks remained normal.

During the present season the work has been continued, and several series of inoculations have been made with different strains of the organism. As a result of these inoculations and reinoculations in which I have tried to follow implicitly the Rules of Proof of Pathogenicity as found in Smith's "Bacteria in Relation to Plant Diseases," I believe I have found a specific cause of at least one form of cherry gummosis.

In the two other cases where I have seen bacteria reported as being associated with gummosis of the cherry, the first, that reported by Brzezinski[1] contained very little information concerning the morphological and cultural characteristics of the organism and all attempts at a comparison of Brzezinski's and my organism were abandoned. In the second instance, that reported by Aderhold and Ruhland,[2] more detailed information was given and I have tried to determine the relationships of the two organisms. The morphology of *Bacillus spongiosus*[2] resembles that of my organism very closely. A difference, however, has been noted in certain of the cultural features. I have not been able to obtain the "vacuolated" or "spongy" appearing colonies in agar or gelatin containing grape sugar, a feature which Aderhold and Ruhland regarded as important, and upon which they based the specific name of their organism. In addition, a chromagenic feature appears when my organism is grown on certain media, namely a greening of the agar in plates, stabs, and slants; in gelatin plates and stabs which are liquefied as well as in old broth cultures, a feature which is not attributed to *B. spongiosus*.

I would have preferred to do at least another year's work before publishing the cultural characteristics and describing my organism as a new species. However, as I have severed my connections with the investigation, I feel it necessary to at least tentatively describe and name my organism as follows:

Pseudomonas cerasus n. sp., an actively, motile, rod-shaped schizomycete, bearing one or two polar flagella, 1.5μ to 2.5μ long, and from .5μ to .8μ in diameter. The rods are usually found in pairs and no long chains have been noted. Spores have not been observed and cultures heated at 80° C. for 15 minutes are killed. The organism stains readily with the common stains, is Gram negative and is not acid fast. It grows on all the ordinary cultural media mentioned in the Society's Descriptive Chart excepting Cohn's solution and silicate jelly. It did not form gas in any of the media tried and it prefers an acid medium to one alkaline. The group number is Ps. 211.2322433.

The manner of infection and method of prevention is yet to be worked out. Ordinarily the fruit spur blight is not serious or abundant enough to justify cutting out, but if the generalized form of gummosis should prove to be of a similar specific origin, systematic cutting out, sterilizing of the wounds and burning of the diseased cuttings would be necessary.

Cherry trees weakened through gummosis fall easy prey to various saprophytic fungi, *Schizophyllum commune, Polyporus* sp. and *Polystictus* sp. being the most common. One of the imperfect fungi, which appears very frequently in the gummosis cankers, but whose identity has not been fully determined, may prove to be at least semi-parasitic in nature.

The growers have found by experience that top working resistant stocks will to a great extent prevent the disease from appearing on the body, or crotch of the tree. The Mazzard seedling is most often used for this purpose although the Morello, Duke and a native western cherry have been successfully utilized. The method is to plant the seedling in the orchard in the usual manner and then top work the branches, preferably by budding at least twelve inches above the crotch, when the trees are two or three years old. This eliminates the gummosis factor from the trunk and crotch, but the disease may later affect the fruit-bearing wood.

The Royal Ann, Bing and Lambert, which are the principal commercial varieties, are all susceptible to gummosis; the Lambert being the most resistant.

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[1] Brzezinski, P. J., "Etiologie du chancre et de la gomme des arbres fruitiers," *Comptes Rendus*, 134 (1902), No. 20, pp. 1170–73.

[2] Aderhold and Ruhland, "Ueber der Bakterienbrand der kirchbaume," Fl. No. 39 der Kaiserl. Biolog. Anstalt. für land- und Forstw., Berlin, 1906.